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Advertisement Index see page xliv. *Official Notices see Sup. 40*

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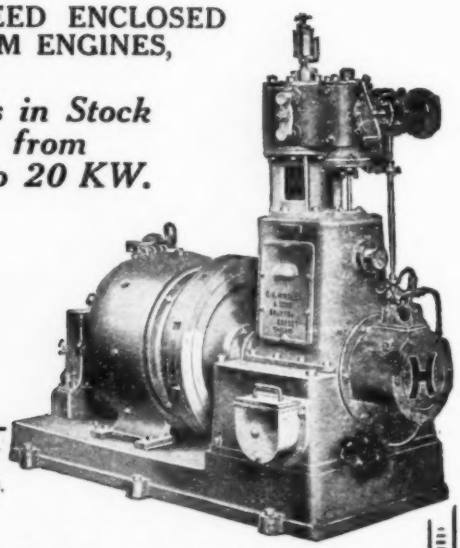

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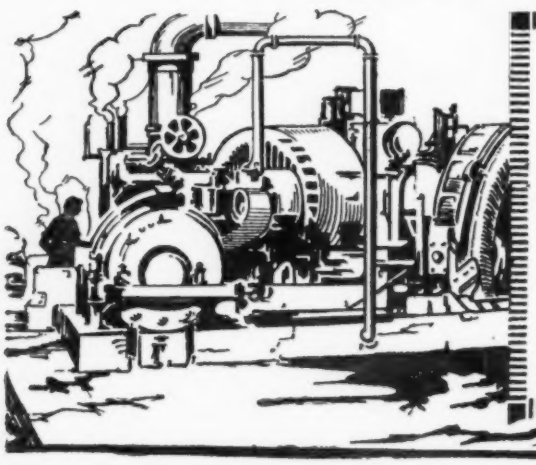

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Electrical Review

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LIST OF FOREIGN AGENTS (see first page "Official Notices").

Contents:

	PAGE
British Electrical Manufacturing Companies	561
Contractors and Municipal Trading	562
Electricity Supply Progress	563
Tramway Speeds	563
Boiler Operation	563
Boiler-room Practice, by John Bruce (*Illus.*)	564
Recent Advances in X-ray Technique, by Mortimer A. Codd (*Illus.*)	566
Electricity from Peat, by W. A. Perry	570
Some New Electrical Terms, by C. Turnbull	570
Those Delayed Deliveries	571
Electrical Trade of France	571
Electrolytic Oxygen and Hydrogen Plant (*Illus.*) ...	572
Parliamentary	573
Legal	574
Business Notes	576
Lighting and Power Notes	579
Tramway and Railway Notes	580
Telegraph and Telephone Notes	581
Radio Notes	581
Contracts Open and Closed	581
Forthcoming Events	582
Notes	582
Institution Notes	585
Our Personal Column	585
New Companies Registered	586
Official Returns of Electrical Companies	586
City Notes	586
Stocks and Shares	587
What is Electricity? by H. E. Yerbury	589
The Development of Power Plant...	591
The Thermal Efficiency of Internal Combustion Engines	592
The London and Home Counties Electricity District	593
Belgium's Industrial Future	594
The Phœnix Telephone Works (*Illus.*)	595
The Electrical and Engineering Exhibits at Wembley (*continued*)	595
Fuel Economy	596
New Electrical Devices, Fittings, and Plant (*Illus.*) ...	596
Correspondence—	
The Recent Traffic Dispute	597
The History of Fused Silica	598
A Would-be Mains Engineer	598
The "Fusing of an Electric Wire"	598
Bakers'-oven Hand Lamps	598
Employment in Australia	598
A Potential Problem	599
Charging for Low Power Facto	599
Cost of Living in Japan...	599
The Dutch East Indian Market	599
Published Specifications	600
Contractors' Column ... ... Advertisement page	xxx

British Electrical Manufacturing Companies.

THE subject of "International Trade" has recently been discussed at a League of Nations Union conference on unemployment, and quite naturally, under the prevailing circumstances, recognition was given to the fact that the relation between foreign trade and unemployment depended on the country in which it was examined. In the United States, for example, the matter is not one which forces itself upon the public mind as it does in Britain or in Belgium, where foreign trade is a vital and pressing factor in the whole trade situation.

All kinds of views were expressed at the conference, some speakers holding that unless we can bring our foreign trade back to pre-war standard we must submit to a general lowering of the standard of life or a state of chronic unemployment for a million or two. The breakdown of the world's markets was held to be the cause of our present distressed condition. The development of production and consumption in the Home market was advocated. Mr. J. M. Keynes cited as a possible cause of unemployment the maintenance of wages (by Trade Unions) at a higher level than the export trades could bear.

We do not attempt any comment upon these and the other views advanced, for we have delivered our soul on the theme on many occasions, and the general unsettlement which characterises the political and industrial situation does not encourage confidence in the ability of the nation to tackle the problem unless it first comes down to earth.

We are more immediately concerned with the recent and the present position of our own section of national industry, respecting which Mr. B. Longbottom has lately given so admirable a review considered from the standpoint of the bulk of our electrical and allied manufacturing concerns, and regarding which chairmen of

several individual manufacturing companies have spoken when giving an account of the directors' stewardship to their shareholders.

It may be useful to record briefly the views of these authorities so that it may be gathered how much there is in common in their various experiences or anticipations.

First, in order of date, and not second in importance, was the speech of Sir George Sutton at the meeting of W. T. Henley's Telegraph Works Company. He had the satisfaction once more of reporting that successful results had attended the year's work. A comparison of the prices of commodities employed in the business and the rates of profit brought out the fact that the output of the factories was larger in 1923 than in any previous year in the company's existence. It ranged in the various departments from 15 per cent. to 50 per cent. more than in 1922. This meant that employment and wages considerably increased while the rate of profit decreased. Is this not what advocates of industrial reform desire? Putting it in another way, Sir George said that the increased demand had enabled them to lower their prices to their customers, to employ more labour, and to maintain the rate of return to the shareholder. He added that a factory well stocked with orders yielded a better output per head of the workers than a factory with a shortage of orders. With regard to the foreign trade side of the Henley business, while this was an important part of the aggregate pre-war turnover, it is now only a small percentage of the total. Some of the lost markets had not been recovered; in such places local works had been built and tariff walls erected to protect them, but a most noteworthy and interesting circumstance, especially when problems of the Empire are recognised to be of pressing importance, lies in the fact that the 1923 balance-sheet—showing the financial result of the biggest output in the company's record—represents prosperity gained in doing Home and Imperial trade. Sir George remarked that if we could so utilise the Home markets as to keep plenty of work in the factories, thus keeping down the cost of production, he, for one, did not despair of regaining at any rate a large part of the foreign trade.

A later speech to which reference should be made is that delivered by Mr. James Taylor at the meeting of British Insulated & Helsby Cables, Ltd. This enterprising company was able to report a slightly larger profit on a greatly increased turnover. This result was attained because improvements effected in factory equipment had increased the efficiency of production so that it had become possible to sell goods at a reduced rate of profit. Mr. Taylor indicated that it was only by such means that they had found it possible to sell at a price low enough to compete with foreign manufacturers. The development of manufacturing operations in Colonial and foreign countries has been a factor operating against this company also, but this adverse feature in the present changing conditions of world trade is accompanied by another operating in its favour, namely, countries which formerly were not purchasers here are developing electric power and buying British products in connection with such work. Further, the Helsby Company has itself begun to produce copper wires and cables at works of its own in India, and has received fairly good orders from the Indian Government.

The Metropolitan-Vickers Electrical Co., Ltd., is not holding its meeting until after we have gone to Press with this issue, but the report of the directors, in which a dividend of 8 per cent. is recommended for 1923, as compared with 12½ per cent. for 1922 and 1921, describes the past year as one of great difficulty. The depressed conditions in other trades of the country have inevitably had their effect on electrical plant and equipment-producing companies; industrial installation work has declined. In addition to this adverse factor—from which there will be relief as industry everywhere gradually revives, as it is understood to be doing notwithstanding all disturbing influences—the company has experienced exceptionally severe competition both in the Home and in the export markets, so that prices on orders secured have been at a lower level than in previous years. It should be borne in mind, however, that 1923 has passed and that there is a large volume of work in progress, the completion and delivery of which may be looked for during 1924 with a favourable effect, it may be hoped, on the results of the current year.

The year 1923 is also described by the Lancashire Dynamo and Motor Co. as a year of great difficulty and scarcity of work. Yet the actual financial result is better than that for 1922, while the position to-day, as indicated by orders in hand, is better than that of a year ago.

The heavy loss reported by the British Electric Transformer Company, Limited, for 1923 occurred mainly in the first half of the year. It was then £19,959, while in the latter half the loss was only £2,171. Further indication of improving conditions is to be found in the statement that at the end of the year the aggregate value of the orders in hand was more than double what it was at the end of 1922, while prices have now reached a more remunerative level. The wisdom of having good reserves under the present varying conditions is shown in this company's balance sheet, for the reserve fund of £62,411 has had to be drawn on to the tune of £17,992, while there is also a contingent liability of £21,000 for cumulative preference dividend unpaid for the past year.

We may include one more company in our present summary—the British L. M. Ericsson Manufacturing Co., Ltd.—as its chairman makes a practice of reviewing the influences that are at work. Mr. W. M. Crowe stated nothing but the truth when he said that continual strikes and the limitation of output were playing into the hands of our foreign competitors, but this has been so often stated without heed appearing to be given to it by those who could improve things, that one almost despairs of the truth being listened to with profitable result. He complained of the national policy of allowing foreigners to dump goods of all kinds here without our asking them for a penny of recompense. His company finds trade with the Colonies satisfactory, but the internal trade of the United Kingdom has been subject to severe competition, and that competition continues. Mr. Crowe appealed for Government consideration of industry in respect of taxation, and made a proposition which has our full approval when he suggested a means by which the Postmaster-General might assist the telephone manufacturing industry of this country—namely, a campaign to popularise the telephone in the mind of the general public. There is almost unlimited scope for a real business-getting propaganda here. Hundreds of thousands of people are not using the telephone to-day who are potential customers. The marvellous growth of radio broadcasting is an indication that large numbers of people are prepared to avail themselves of developments in this class when they are brought within the compass of their purse and when facilities are placed within their reach. The public generally, the Post Office Telephone Department, and the entire telephone branch of the British electrical industry, would all feel the benefit of a really enterprising advance telephone policy for the United Kingdom.

Contractors and Municipal Trading.

When the Wakefield Corporation Bill came before a Select Committee of the House of Lords recently, the Electrical Contractors' Association was successful in securing the striking-out of a clause which would have enabled the Corporation to sell and deal in electrical appliances.

Acting upon precedent, the Association brought up to date figures which were used in 1912, in opposing the Sheffield Corporation, which was seeking similar powers. These were statistics of progress in a number of munici-

palities—the advance being shown by the increased consumption of electricity per head of population. By this means the Association was able to show that progress had been most rapid where the municipal authority possessed but restricted trading powers or none at all; the authorities which were in possession of full trading powers and were partly exercising them showed the least progress. Between these were the local authorities vested with full powers and exercising them fully, and those with unexercised powers. These were respectively third and second in the list.

While it is to be borne in mind that only 88 authorities out of a total of between two and three hundred were thus accounted for, it is clear that the Electrical Contractors' Association presented a good case. At one time we were inclined to believe that electricity would develop far more fairly if the local authorities were forbidden to compete with their ratepayers in the sale of appliances. Since that time, however, matters have changed somewhat. Many municipal authorities are becoming impatient and wish to secure powers to sell apparatus themselves. In this matter the question of "service" arises. Hitherto contractors have not been able, for the greater part, to do any more than sell an appliance—out of stock, out of mind—whereas several municipalities have organised "service" departments to keep an eye on the subsequent life of apparatus. This is the American way and, to our mind, the only way in which the domestic consumer is to be attracted to the use of more and more appliances.

Perhaps, with registration, we may see a new kind of contractor who will either undertake to look after apparatus which he has supplied (charging a small fee for repairs), or co-operate with the municipal suppliers of electricity in this respect—a course which the Wakefield Corporation appears to have been unwilling to follow.

Electricity Supply Progress.

It is interesting, as the years roll by, to observe how stages of development are reached, in one or other branch of engineering, at which progress slows down and the belief gains currency that the limit has been nearly attained in that direction. But invariably the tree of science throws out another bud which quickly grows into a strong branch and proves that finality is unapproachable—that there are more things in heaven and earth than are dreamt of in the philosophy of the moment.

In the field with which we are most nearly concerned we have seen the carbon lamp developed apparently to its limits, only to be superseded by the metallic filament type, and doubtless a time will come when that in turn will give way to a vastly more efficient source of light such as is already known to exist in nature. We have seen, too, the reciprocating engine brought up to a remarkable pitch of efficiency and output—then comes the turbine, and power station practice undergoes a complete revolution, until we are told on the highest authority that there remains but little scope for further progress in efficiency. Nevertheless, as Mr. W. H. Patchell indicated in his interesting inaugural address as president of the Institution of Mechanical Engineers, and as was stated by Mr. C. W. E. Clarke at the Vickers dinner last week, power station practice at this moment is in a transitional stage and fundamental changes are taking place, this time in the boiler-room, where, as we have often pointed out, there is by far the greatest scope for improvement. But Mr. Patchell, in closing his address, foreshadowed still more striking changes in the utilisation of fuel, including the rapid development of the gas turbine as a practical machine.

In the meantime equally rapid progress is being made in the transmission of electrical energy at extremely high voltage, both overhead and underground, and it is clear that throughout the technical side of the business of electricity supply continual advance is being maintained, which we rejoice to see. But the question remains: Why is the consumption of electricity in the United States over 500 kWh per head of the population whilst in this country it is hardly one-fifth of that amount? Is it because of the adoption of the various aids to economy which are mentioned in our pages to-day, or because of the use of high-voltage transmission, or of any other technical device? We have no hesitation in stating that it is due to no such reason. Mr. Patchell hits the mark when he says: "It is because people have, after study, gone out to sell it, and they have sold it."

There is, in fact, far too much emphasis on engineering in the electricity supply business in this country and far too little on commercial management. It is not sufficiently recognised that *it is a business*, and should be run on business lines. In the few places where that policy has been adopted, success has immediately followed. We would say to the managers of our supply undertakings: *Sell electricity*! Do not merely supply it to those who come and ask for it—take it to the public and sell it. Do this, and all these other things—big sets, thermal economy, &c.—shall be added unto you. They are not the cause but the consequence of big sales. Low costs can be attained with existing plant; superstations are not the secret of success—we can point to cases where the biggest undertakings are hopelessly beaten in selling price by small ones. It is at the distributing end of the business that by far the greatest scope for progress is to be found.

We are happy to see that the splendid work done by E.D.A. is bearing good fruit, that its activities are being more and more appreciated, and that it is rapidly gaining support. But E.D.A. cannot do everything—the local manager must exert himself, for the future of electricity supply is in his hands.

Tramway Speeds.

So much has been heard of the London traffic problem recently that it may be tiresome to revert once more to the subject. Nevertheless, at a time when electric tramways are held to be on trial for their life, any evidence which may be produced in their favour deserves attention.

One of the charges against the tramways in London is that they monopolise roads to the disadvantage of other transport. They are accused of too-frequent stops and absurdly low speeds. What bases these charges have is not known, but, like many charges of a general nature, they may be due to the unfortunate experience of individuals who are able to gain the ear of the public through the Press and otherwise.

It is a curious fact, however, that while, according to Lord Ashfield's statement at the annual meeting of the operating companies of the "Underground" group, the average speed of traffic in London has fallen from eight or nine miles an hour in 1914 to four or five miles per hour nowadays, the average speed of the L.C.C. tramcars, as given in the last tramway returns issued by the Ministry of Transport, is 9.29 miles per hour, as compared with 8.95 miles per hour in 1914-15. At the same time, the company undertakings also made good showing. The London United Tramways' average is 8.70 miles per hour; the Metropolitan Electric Tramways returned their average speed as 9.23 miles per hour; and the South Metropolitan recorded a figure of 9.17 miles per hour. It looks as if the reason for the slowness of London's traffic will have to be sought elsewhere.

Boiler Operation.

As it is in the boiler room that there is the greatest opportunity for saving coal, too much attention cannot be given to the operation of the plant which it houses. Measurement of the various quantities concerned is the first step towards increased efficiency; tabulation of the records is the second; but all this work is wasted unless the records are scientifically interpreted. How to do that, with the aid of the system devised by Mr. R. H. Parsons, is the subject of an important article by Mr. John Bruce, which appears in our later pages, and which we commend to the notice of station engineers who wish to reduce their fuel costs.

Boiler-Room Practice.

The Analysis of Operating Results.

By JOHN BRUCE, A.M.I.E.E.

It has been pointed out in a previous article that the value of any system for the tabulation of power-station operating records depends upon the information tabulated and the manner in which the records are set out. Any system to be efficient must provide every facility for the rapid analysis and evaluation of the various losses, and at the same time indicate the sources of such losses. It is recognised, of course, that the first essential towards increased efficiency or a decrease in the cost of generation is a record of the performance of each unit of equipment comprising the generating plant. Though this fact is, or should be, obvious to everyone engaged on the generating side of the industry, it is deplorable to find in many power stations, even in those of considerable capacity, that while minute details concerning generator and feeder loads are religiously entered in the operating log-sheets, very seldom is any attention given to the tabulation of boiler-room, turbine, and condenser operating conditions.

Even in generating stations where the last-mentioned conditions are carefully tabulated, it is often the case that at the end of the day, or other period, the various log-sheets, containing valuable information, are filed away, and no attempt is made to scientifically analyse the operating figures or make any use of the tabulated data. In the past, the lack of simple methods for the analysis of operating results undoubtedly contributed greatly to the apathy already shown towards scientific efficiency control, and the time necessary to systematically set out in final form a maze of operating figures could not be devoted to it.

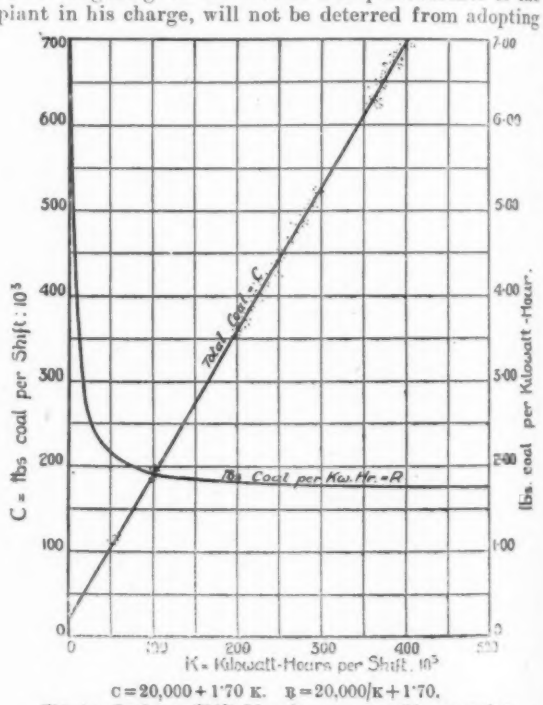
A few years ago a system was devised by Mr. R. H. Parsons, whereby, with a minimum of measurements and computation of results, the operating efficiency of any power station, from day to day, could be readily estimated to quite an acceptable degree of accuracy. Briefly, the system provides a graphic method of analysing the operating results by reducing coal and steam consumption to a comparable basis, and further, permits the determination of the constant losses of boiler room and turbine room. The system can also be applied to the solving of problems relating to fuel costs for additional load, and financial questions in relation to bulk supplies, &c. Further, the method enables an estimate to be made of the effect on the coal consumption of any increase or decrease in the load demand, shows graphically the limiting efficiency of boiler room and turbine room, and, not the least important, provides a basis for the payment of the station operating staff on a bonus system governed by the operating results.

The principles upon which the system is founded are fully described by Mr. R. H. Parsons in "The Coal Consumption of Power Plants and Bonuses for Coal Saving" published by the Electrical Review, and in "Power Station Efficiency Control" published by Sir Isaac Pitman & Sons, Ltd.; therefore it is intended to confine this article to a description of the application of the system, as a help in the analysis of the operating results and as an aid towards the maintenance of efficient operation in the case of a large power station.

The factors involved in the successful institution and operation of this system of analysis are as follows: The coal fed to the boiler furnaces must be weighed or metered, and the quantity consumed in any period of time must be capable of being determined. The steam utilised by, or the condensate discharged from, the turbine-room plant, and the make-up feed-water, must be measured. Finally, the electrical output of the generating plant must be metered. The last-named value can either be the total kilowatt-hours generated or that delivered to the feeders. Both values of the output, however, can be incorporated in the equations and a check thus provided on the consumption of electrically-driven auxiliaries. All the factors enumerated above must be determinable over any period of time.

In the case of the smaller power stations and, though a sad admission, in some instances in power stations of considerable size, the values of the necessary factors, with the exception of the electrical output, cannot be readily determined, owing to a lack of the necessary instruments for boiler-room and turbine-room measurements. Possibly, in such cases, the make-up feed-water may be determined however, due to the fact that the water authorities provide the necessary metering apparatus if the make-up supply is drawn from the town mains.

The conscientious and enthusiastic engineer, desirous of investigating the conditions and performance of the plant in his charge, will not be deterred from adopting



C = 20,000 + 1·70 K. R = 20,000/K + 1·70.

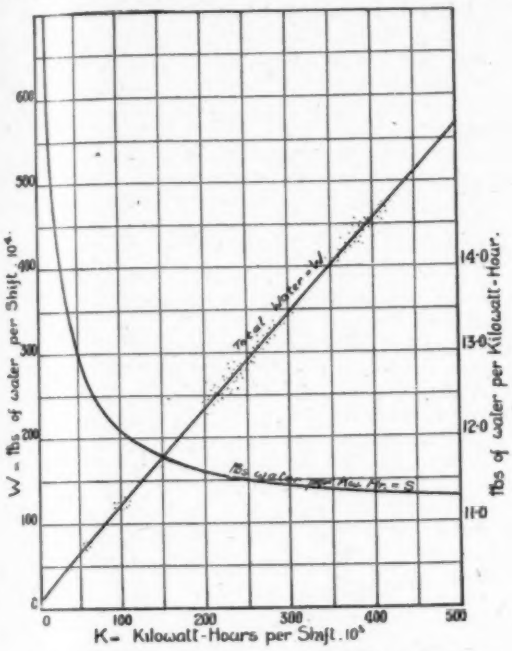
Fig. 1.—Coal per Shift Line for one month's operation.

the system for lack of automatic measuring gear. As described in a previous article, where chain or travelling grate stokers are installed, a knowledge of grate speeds and fire-bed thickness in conjunction with a simple form of log-sheet for reporting times and changes in these factors, will supply a figure for coal consumption, sufficiently accurate for all comparative purposes. The estimation of the total steam or water evaporated presents a more difficult proposition, but if the turbine-room equipment consists of machines of the impulse type, the throat areas of the first stage nozzles, number of nozzles in operation, and the steam conditions of pressure and temperature before the nozzles are the necessary factors from which the turbine-room steam consumption can, as the writer has found on various occasions, be calculated to quite a close degree of accuracy.

To return to the case of the power station under consideration, the coal fed to the boiler furnaces is metered by Avery automatic weighing machines, installed at the top of each stoker hopper chute, the weight of each charge of the weighing machine being 224 lb. The total weight of steam or water evaporated is measured in the following manner: Each turbo-alternator unit is equipped with a Lea recorder, indicating, recording and integrating the weight of condensate.

The make-up feed-water from a water-softening plant is measured by a "Leeds" rotary water meter, installed in the make-up feed-water pipe line, and the make-up feed-water produced by Weir evaporating plant is metered in a similar manner. The electrical output of each alternator is measured by a two-element watt-hour meter mounted on the control panel of the unit.

The station is provided with a generous equipment of


W = lbs of water per Shift. 10⁴
K = Kilowatt-Hours per Shift. 10³
lbs of water per Kilowatt-Hour.
Total Water = W
lbs water per Kilowatt-Hour = S

$w = 100{,}000 + 11{\cdot}10\ \kappa$. $s = 100{,}000/\kappa + 11{\cdot}10$.

Fig. 2.—Water per Shift Line for one month's operation.

instruments for scientific control, and the plant is operated from the interpretation of the instrument indications, a half hourly log-sheet record of all indications being kept for each section of the station, *i.e.*, boiler room, turbine room, and control room.

All integrating instruments connected with operation are simultaneously read at the end of each eight-hour shift and the readings entered in their respective log-sheets.

Coming now to the institution of the Parsons system of analysis co-ordinating the above-mentioned factors, the method of determining the standard "lines" is as follows: At the end of each month, in the case of the station referred to, the operating results for each eight-hour shift are plotted on two graph fields, as shown in figs. 1 and 2. Referring first of all to fig. 1, this shows the coal consumption on a base of kilowatt-hours generated. The standard line for coal consumption is obtained by plotting the coal consumption against the electrical output for each shift for the month under consideration. The line representing the average performance of the station is then drawn in through the groups of points obtained, the accuracy of the position of the line being checked as described later.

Fig. 2 shows the total water evaporated on a base of kilowatt-hours generated. The points are plotted and the standard line obtained, by dealing with the water evaporated and the electrical output per shift, in a similar manner to that employed in the determination of the standard coal line. The range of output dealt with will be seen by a reference to the diagrams. From fig. 1 the following equation is deduced:—

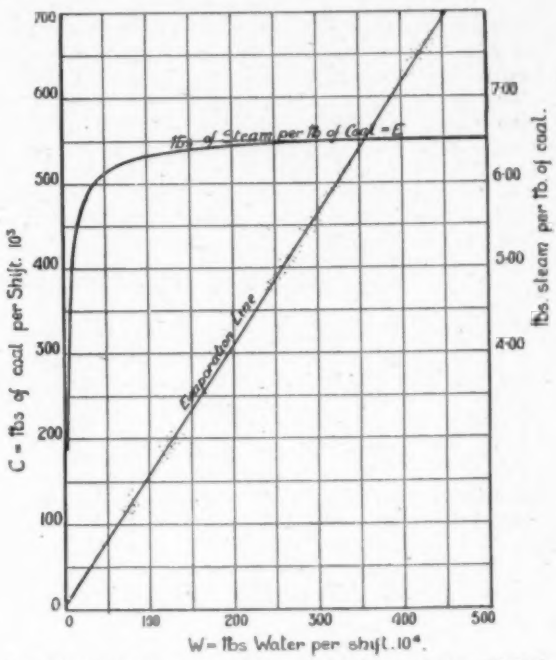
$$c = 20{,}000 + 1.70\ \kappa \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where c = lb. of coal consumed per shift,
and κ = electrical output in kilowatt-hours per shift.

Fig. 1 also shows the curve of lb. of coal per kilowatt-hour as a function of the total kilowatt-hours generated per shift. From fig. 1 the principal deductions are as follows:—

(*a*) The no-load coal consumption is 20,000 lb. of coal per shift.

(*b*) The minimum coal consumption is approximately 1.75 lb. per kilowatt-hour generated.



$c = 4{,}690 + 0{\cdot}153\ w$. $w = 6.54\ c - 30{,}650$. $e = 6.54 - 30{,}650/c$.

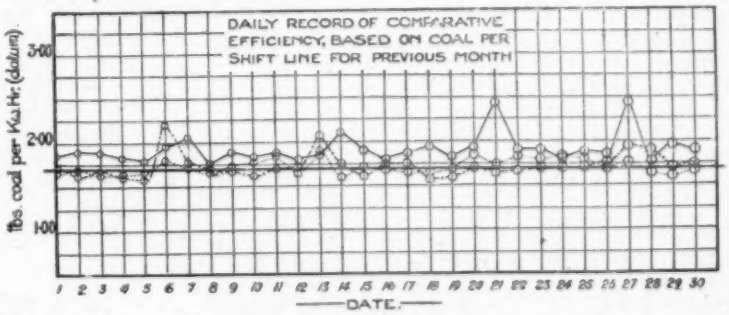
Fig. 3.—Evaporation Line for one month's operation.

The relationship between the water evaporated and the electrical output per shift is dealt with in a similar way in fig. 2. The following is the equation deduced for the standard line:—

$$w = 100{,}000 + 11.1\ \kappa \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where w = total water, in lb., evaporated per shift,
and κ = electrical output in kilowatt-hours per shift.

From fig. 2 the following deductions can be readily made:—



Equation from coal line for previous month: $c = 20{,}000 + 1.70\ \kappa$ lb. per kWh.
Datum $= 1.70 = (c - 20{,}000)/\kappa$. Night shift line, plain; day shift line, dotted; afternoon shift line, dot-dash.

Fig. 4.—Daily record of Comparative Efficiency.

(*a*) The no-load steam consumption, or water rate, is 100,000 lb. per shift.

(*b*) From the curve of lb. of water per kilowatt-hour it is seen that the minimum water rate of the station is approximately 11.3 lb. of water per kilowatt-hour generated.

By eliminating κ from equations (1) and (2), equations (3) and (4) are obtained; these are:—

$$c = 4{,}690 + 0.153\ w \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$$w = 6.54\ c - 30{,}650 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

These equations, (3) and (4), form a reliable check on the accuracy of the position of the standard lines in figs. 1 and 2, and since they show the co-relation between coal and steam consumption, they must also satisfy the

standard evaporation line shown in fig. 3. The evaporation line is obtained in a similar manner to the lines in figs. 1 and 2, *i.e.*, by plotting the coal consumption and water evaporated for each shift of the month in question. In practice it may be found that the trial positions of the various lines do not satisfy all the equations, and their positions must therefore be adjusted until the equations for each of the three lines are consistent with one another.

From equation (3) it is seen that the coal consumption per shift necessary to maintain the plant under normal conditions of temperature and pressure is 4,690 lb. In other words, this is the amount of coal necessary to make good the furnace, boiler and range radiation losses. From equations (1) and (3) the difference between 20,000 lb. and 4,690 lb., *i.e.*, 15,310 lb., represents the amount of coal necessary to maintain the no-load losses of the turbine room and operate the auxiliary plant. From equation (4) it is seen that the maximum evaporation per lb. of coal consumed is approximately 6.5 lb. of water. Therefore knowing the average calorific value of the coal, which for the month under consideration was 10,300 B.th.u. per lb. "as fired," and also knowing the conditions of steam pressure, steam temperature, feed-water inlet temperature, &c., the efficiency limit of the boiler room is found to be in the neighbourhood of 80.00 per cent.

For the purpose of bringing clearly to the operating engineer's attention any progressive increase or decrease in the operating efficiency of the station, use is made of the constants in equations (1) and (2). In this case these constants are 1.70 and 11.1 respectively, and as will be shown presently, these form a basis, or datum, against which the shift to shift operation is compared during the following month. It is seen from equation (1) that after allowing for the constant losses, the coal consumption is 1.70 lb. per kilowatt-hour for all outputs, therefore this datum figure 1.70 forms a basis against which the following month's results can be compared. For example, when the operating statistics come in at the end of an eight-hour shift, if the constant representing the stand-by losses is first subtracted from the actual consumption and the remainder divided by the kilowatt-hours generated, the figure obtained will be 1.70, provided the efficiency has been maintained at the previous month's standard.

An actual example of one month's operating results, plotted against the coal datum obtained from the equation for the coal line in fig. 1, is shown in fig. 4. The effect of banking losses at week-ends should be noted. In a similar manner, the constant from the equation for the water line in fig. 2 provides a datum against which the station water rate is recorded, the two charts thus providing, on a fair basis of comparison, a continual graphic record of the station operation.

In the case of the power station in question, the monthly datum is not kept at a fixed value, but is altered at the end of each month according to the average monthly efficiency of the station. The value of the system for the analysis of operating results is considerably influenced by the care with which the operating data are tabulated, and a point of great importance in the record keeping is that all coal meters, steam or condensate measuring apparatus, electrical meters, &c., must be read simultaneously. This can be accomplished by the use of suitable signalling apparatus between the switch-gallery or control-room and the turbine room and boiler rooms.

Recent Advances in X-Ray Technique.

By MORTIMER A. CODD.

The uses of X-rays may be divided for purposes of convenience into two classifications, radiography or the visual or photographic investigation of materials, and treatment, or the medical application of the rays for therapeutic purposes.

The apparatus can be divided into four main categories, the source of high-pressure current and its controls for exciting the tube, the tube itself with its appurtenances, the screen or photographic plate for reading the shadows cast by the object, and the measuring apparatus.

Many years ago* the writer suggested that X-ray apparatus should be designed as a responsible piece of electrical machinery, but till the outbreak of war little was done in this direction. Service conditions, however, imposed a certain strengthening of existing apparatus, and the products of the instrument maker assumed a robustness which was a step in the right direction. Owing to the great advances in the electrical pressures used to-day, however, a great deal remains to be done in the strengthening of the apparatus both electrically and mechanically, particularly in sets for treatment and for commercial radiography, owing to the pressures used (which are in the neighbourhood of 200,000 volts, and still increasing).

Taking first the sources of high-pressure supply, these may be divided into two headings, the coil and the transformer.

The selection of either of these sources is determined to a large extent by the current available from the local mains.

In the U.S.A. most of the current supplied is alternating, hence we find that the Americans are chiefly exponents of transformer sets, whereas in Europe where direct current is chiefly available, coil sets preponderate. Undoubtedly, coil sets are superior to the transformer for the finest work, especially if medium to high pressures have to be used; on the other hand, the coil requires intelligence in its handling, whereas a transformer set is more or less fool-proof, and is naturally particularly effective in producing rays of soft to medium hardness.

In the U.S.A. some little success has attended the use of improved forms of Wimshurst machines, but owing to climatic conditions such machines have never proved successful in Europe up to the present.

As indicated, the main source of supply from the inception of X-rays has been the coil supplied from direct-current mains, but the modern coil is a vastly improved form of apparatus from the old Ruhmkorff coil in use when X-rays were first discovered.

Early experimenters soon found the necessity for heavier outputs from the coil, and though it was some time before it was discovered how this could be effected the present-day coil is fully able to give any output the tube is capable of consuming; indeed, there is always a state of competition between coil makers and tube makers, for, as soon as the output is raised by superior apparatus the tube makers claim to go one better, but it will generally be found that it is the tube which is behind-hand.

As the output from the coils began to be raised, naturally their size increased and a great deal of confusion as to their true output was caused by makers classifying their coils as "16-in," or "24-in." coils, although the sparking capabilities of a coil were bounded by the positions of the discharge pillars, which on a 24-in. coil were frequently set at 12 in., the

* Electrical Review, May 20th, 1904, p. 853.

specious argument being that the coil would give a 24-in. spark, but for the sake of safety and to obtain a heavier current the coil should not be forced above 12 in. As a matter of fact, for ordinary work for radiographic purposes a working gap of 8 in. is ample, but this was the state of affairs at the outbreak of war.

Let us now consider the outstanding features of the coil which render it pre-eminent as a producer of X-rays. The X-ray tube, broadly speaking, is governed as to its hardness or penetration by the applied pressure, and in the volume of the rays given off by the quantity of current supplied, and also, the writer maintains, by the frequency (and wave form) of that current. The current from a coil examined by an oscillograph while passing through a tube shows a sudden, almost instantaneous growth, and it is due to this shock excitation

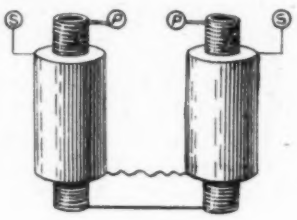


Fig. 1.

that the impulse ratio of the tube is high and, therefore, X-rays of great effectiveness are given off.

It will be advanced that if the tube is supplied with really continuous current, such as would be given by a battery of cells or by a Wimshurst machine, the current will be continuous through the tube, and there will be no impulse ratio whatever.

I believe, however, it will ultimately be found that under those circumstances the current through the tube is not continuous, but of a direct pulsating value only, a condition imposed by the tube itself if it is to emit X-rays.

I suggest this is due to the inherent capacity of the tube (most tubes have a capacity "cold" of about 2 to 3 micro-microfarads) and this capacity is responsible for an impulse ratio being latent in the tube even when supplied with truly continuous current and therefore for the production of X-rays.

This contention is, I think, strengthened by an experiment recently carried out by Mr. E. S. Evans, in

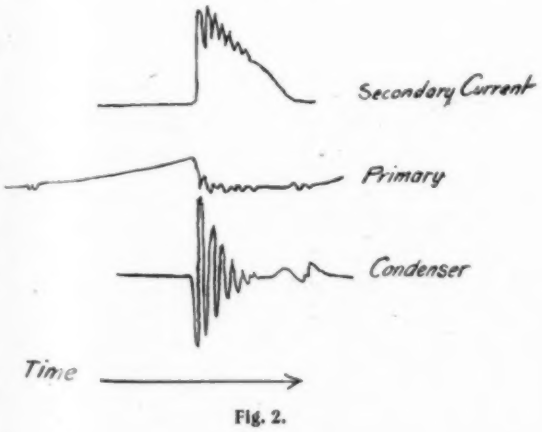


Fig. 2.

which it was demonstrated that a helium tube fed from a large Wimshurst when viewed in a rotating mirror showed distinctly that the current through the tube was not continuous but pulsating in form.

The ultimate aim, therefore, of the operator should be to give as many impulses of as great a magnitude as possible in the time allowed for exposure.

The magnitude of the impulses obtainable with a given coil is to a large extent governed by their frequency when the mains voltage is fixed. We are in the position, therefore, of using a large coil of high self-induction to give impulses of great magnitude, but of relative slowness, or a small coil of low self-induction which can be run at a higher interrupter speed but gives relatively smaller impulses.

During the early part of the war the writer experimented with two or more coils in series, fig. 1, the object being to raise the rate of interruption at which the coils could be run without increasing their total self-induction, and also to better the insulation between the primary and secondary, which is of increasing importance with the rise of pressure used for treatment.

A similar arrangement of coils was subsequently disclosed at the termination of the war when the Erlangen treatment for cancer received a certain amount of newspaper publicity.

The arrangement of coils was very similar to that already outlined, being primarily intended for treatment only, but certain arrangements were made in the secondary circuit with the object of discharging the tube between impulses and damping out high-frequency effects in the tube.

The writer has been unable to trace these high-frequency manifestations by oscillographic examination, particularly where they are chiefly indicated in the German apparatus. False h.f. effects can be demonstrated at the secondary terminals, however, by using too large primary condensers which give parasitic impulses superimposed on both the primary and secondary wave forms, fig. 2, and since the German apparatus is of the kind using large impulses at a low rate of speed in order not to fatigue the tube, it is possible that these condenser surges give place to what have wrongly been called h.f. effects in the secondary and tube.

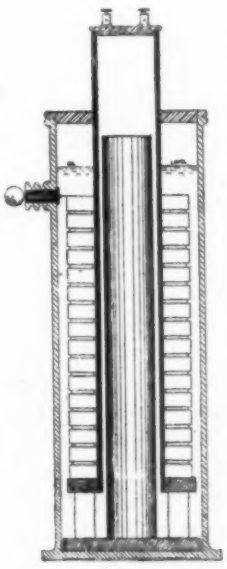


Fig. 3.

Equal or better effects can be obtained by using two coils, preferably with an earthed neutral point, and two relatively small symmetrically disposed spark gaps in a nitrogen atmosphere on either side of the X-ray tube, the chief desideratum being a smoothly running coil furnishing ample pressure.

Unfortunately, wax insulated coils hitherto used with quite satisfactory results are found to be defective on protracted runs required for mass treatment with X-rays.

After some hours' use the wax insulation becomes plastic, or even liquefied, spurting sometimes violently from the coil.

Subsequent examination does not reveal any clear point of breakdown, indeed such coils are usually good for another run of several hours, when the same defect will again occur. Various suggestions have been made, the most feasible being that the current density of the windings is too high, but in the cases which the writer has examined this suggestion will not hold water. The cause is undoubtedly due to dielectric hysteresis, which becomes considerable when dealing with varying pressures of the order of 150 to 250 thousand volts, pressures which will undoubtedly be increased in the near future to voltages of double or more.

In view of these circumstances makers are increasingly adopting oil insulation as a cure for the trouble of brushing and subsequent breakdown. The coils first designed by the writer are constructed vertically, the secondary being of layer windings in several sections (fig. 3). The sections are so separated as to form ducts through which the oil can circulate for purposes of cooling, the whole being arranged in porcelain tanks. The entire arrangement indeed follows more commercial designs for high pressures than hitherto, since it seems

illogical to assume that the pressures used for X-ray work need unreasonably lighter insulation than similar pressures used for commercial purposes.

At the moment the weakest link in the coil set is undoubtedly the interrupter. These are almost entirely of the mercury turbine type, a form which till recently gave very good results for radiography, but the larger

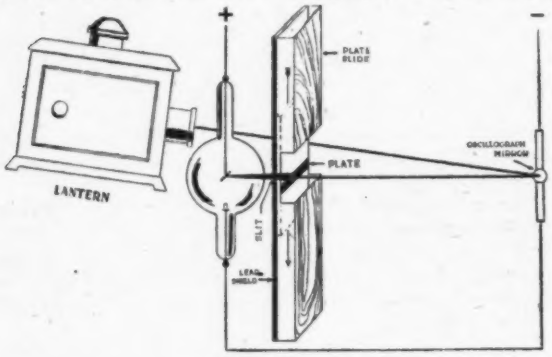


Fig. 4.

coils and more protracted runs now used in treatment work quickly show up their latent weaknesses. These are, briefly, the fouling of the mercury in the gas dielectric, defective bearings which are noisy and allow the escape of gas, an inability to pump satisfactorily at all speeds, particularly when running on a.c., and finally the absence in many of a means of varying the time economy of make and break.

Cleansing a mercury interrupter is naturally a nasty duty which everyone shuns till it is forced upon one, but the regular running of the tube depends vitally upon it. Yet the improved mercury break is still to come, and if possible a touch of heavy engineering will be welcome when it does arrive at length.

A good break would save the lives of countless punctured tubes and spoiled negatives.

For rapid radiographic work the Wehnelt break has many adherents, three or four points in parallel being used with a current of 100 amperes or more, the switch being closed and opened again by hand.

This method, brutal and unscientific as it is, cer-

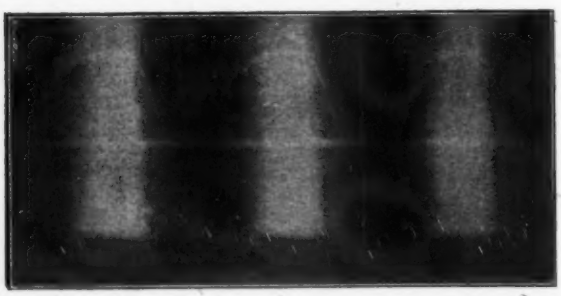


Fig. 5.—Rectified Alternating Current, Sine Wave. Thermal Tube

tainly gives good results, provided the main fuses will stand it, but it seems likely that further advances will soon render its use unnecessary.

Turning now to the use of transformer rectifier sets, we meet to a certain extent the same difficulties in insulation which are being circumvented by the use of oil insulation. The use of transformers, however, brings into play an entirely different chain of conditions since we are dealing with a wave of sine form as opposed to the impulsive spear-shaped wave generated by the induction coil.

The sine wave delivered by the transformer, however, is modified to a greater or lesser extent by the rectifying device, the average angle of collection being about 30 deg.

The angle of collection should be governed by a consideration of the use to which the apparatus is to be put; thus for soft tubes a larger angle of collection can be more usefully and economically employed than for hard tubes.

Unfortunately, manufacturers are led astray by the desire to exhibit a large milliampereage through the tube, regardless of whether a large current signifies a corresponding increase in useful rays manifested.

Practically only the peak of the wave collected is of use in producing X-rays; the harder the ray the smaller the angle of collection, varying from 10 deg. to 45 deg. in practice. To prove this point which was for some time held to be debatable, the writer arranged the following experiment.

The main current through the tube (of the order of 50 mA) was passed through a Duddell oscillograph of the falling plate type. The tube itself was arranged to give its rays through the slot in a suitably disposed leaden shield on the back of the same plate as that on which the light spot of the oscillograph fell (see fig. 4).

Fig. 6.—Coil-interrupted Current. Gas Tube.

The falling plate was consequently acted upon simultaneously by two agencies, the rays from the tube and the current actuating that tube.

When developed the plate showed definitely that only the peaks of the curve were X-radioactive (fig. 5).

Coil curves so examined showed similar results, but although the X-ray band was narrower it was much more strongly marked (figs. 6 and 7).

To obtain automatically varying angles of collection for use with either medium or hard tubes the writer has used a collecting device of the spherical type with sausage-shaped collector segments on the rotating disk. This gives a species of horn lightning arrester effect, which enables the machines to adapt itself automatically to the conditions obtaining. It is particularly useful, however, for hard tubes where the difficulties of collection become great owing to the limiting size of the collector disk. It will be apparent that on high periodicity circuits, and when high voltages are necessary, the circumference of the disk must become too great for practical politics. This difficulty has been surmounted by employing two disks, either with two transformers in series or by using the earthed neutral point method giving rectification to 200,000 volts or more.

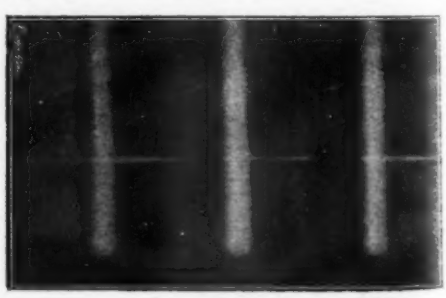


Fig. 7.—Coil-interrupted Current. Thermal Tube.

Dessauer, of Frankfort, uses two compass-needle shaped rotors about a yard in diameter, having a very small angle of collection. In the larger sizes of apparatus he arranges several transformers each giving 50,000 volts in cascade, each transformer being insulated on porcelain supports of increasing size proportional to the increase of voltage. The set that the writer saw working gave 500,000 volts, but the discharge was disappointing, giving the impression that the overall efficiency was poor.

With these high voltages no attempt at rectification was made, two tubes in parallel end for end being used,

each tube utilising one half cycle, and two patients at a time being treated. The tubes used were of special German manufacture of the Coolidge type.

The design of transformers for X-ray work follows generally standard practice, that is, closed core transformers are used with sectional windings immersed in oil in iron tanks.

Better results can be obtained with open core transformers, but the no-load current with powerful sets precludes their general use.

With respect to tubes, the advent of the Coolidge tube has done much to standardise the use of X-rays, owing to its superior stability and ease of manipulation, but the gas tube still retains its superiority in skilled hands. Since the introduction of the boiling-water-cooled tube great advances in the gas tube have been made, and for treatment purposes such tubes are superior to the thermal type. The manufacturers of X-ray photographic plates too have not stood still, and apart from intrinsic improvements in their manufacture, we now have plates specially suited for use with intensifying screens as well as plates actually coated with the active intensifying agent which may be washed off before development. All these improvements materially shorten exposure, rendering X-ray work more and more a standardised performance.

With the growing use of high pressures and shorter wave lengths the question of installation and protection become of insistent importance.

With pressures of about 200,000 volts the leads from the generator to the tubes, and even the tube itself, require improved insulation. This is largely overcome by using stout polished metal rods terminating in balls or employing gentle bends instead of the overhead wires heretofore employed. The generating apparatus should be placed in a separate room with a plate glass partition through which the conductors may be led directly to the tube, and such excellent conditions are to be found abroad where space is of little account, but in this country existing conditions unfortunately are against such ideal disposition.

The tube itself can be oil-immersed not only to cool it but to prevent brushing and corona effects tending to puncture.

Whatever limitations may be experienced, some attempt on the above plan must be made to minimise the production of ozone by brushing, which if not countered very soon renders the atmosphere of the room impossible for the operator, even when well ventilated.

A second and more insidious danger lies in the use of increasingly hard rays without a commensurate increase in the protection afforded the operator by an adequate thickness of lead rubber, lead glass, or sheet lead. Every care should be taken fully to carry out the recommendations of the revised report of the X-ray and Radium Protection Committee in this respect.

The result of such adequate protection is to make tube holders, screening stands and the like extremely heavy, bulky, and costly, and it seems probable that in the near future protection will be afforded by using a fixed oil-immersed lead-covered tube and moving the patient instead of the tube; indeed, such sets are already in use on the Continent.

Lastly, we come to the most important and most neglected point in connection with X-rays, that is, their measurement.

In 1905 the Röntgen Society appointed a Committee to investigate the question of standardisation, but despite considerable discussion the findings of the Committee, if any, remain undisclosed.

For many years and even to-day the standard most commonly used is the darkening of a small barium platinocyanide disk, the Sabouraud Noiré pastille, which is to some degree a measure of the quantity of rays, and the Benoist penetrometer, an arrangement of aluminium steps of increasing thickness, used to determine the hardness of the rays. Since both these devices, particularly the pastille, depend on the degree of judgment of the operator they remain unreliable. Although the results of the operator's observation may be consistent there is no means of comparison or co-ordination between the results of different workers, since the measurement depends on their individual judgment.

With the advent of heavy-voltage treatment the question became increasingly important and selenium cells with an empirically calibrated galvanometer were used to some extent on the Continent. Such devices, however, have fallen into disrepute apparently owing to their unreliability. The one reliable method which has found any favour is that based on the discharge of an electroscope by ionisation as in the Szillard, Solomon and other ionto-quantimeters. These, however, depend on the time taken to discharge and are more suited to the laboratory than the hospital, since the conditions measured may change while the reading is being taken. None of these devices, moreover, appear to be based on any particular common unit, some being calibrated in physiological, others in physical units. The unit of radioactivity for some reason does not appear to find much favour apparently owing to its inconstancy.

Apart from the Benoist and similar penetrometers hardness has been measured in terms of the spark gap between points.

Recently, however, measurements have been made in some quarters between spheres, a retrograde step, as, apart from such a gap being much faster than the point gap, the capacity of the spheres required for high pressures is sufficiently great to destroy actually the condition one sets out to measure. The same disability attends the use of electrostatic voltmeters of the Bauer, Kelvin, or Abraham type, as well as the accompanying errors due to varying wave form which may exceed 50 per cent. It would appear that the best solution of the measurement of hardness or the wave length of the rays in use is to employ a spectrometer of the Bragg or Zeemann type, but unfortunately again such apparatus does not lend itself to quick and general usage such as medical requirements in particular demand, omitting alone the obstacle of price.

There remains the question of frequency and wave form, the latter of the greatest importance, but since an oscillograph cannot be provided with every set we must content ourselves with examining one type of apparatus, perfecting it and reproducing it with as much exactness as possible.

In view of the increasing importance of X-rays in radiography and therapeutics, and in the use of X-ray spectra with respect to the structure of atoms as well as in more commercial applications, it is to be hoped that some practical but reasonably accurate methods of measurement will shortly be found.

Boiler Explosion Inquiry.—Mr. C. H. Thirkell has presented a preliminary report to the Board of Trade upon a boiler explosion which occurred in the Aberdare municipal power station on November 29th last. On this occasion seven men were injured, one of whom died subsequently. The boiler was of the B. & W. marine type, having 280 water tubes 4 in. in diameter. The boiler was about 13 years old, and a number of repairs had been made from time to time, including the replacement of a defective tube in May, 1922. The explosion occurred in the new tube, which was ruptured longitudinally for a length of about 11 inches. The opening formed was 5¾ in. at the widest part, and through it the contents of the boiler escaped. The explosion was due to overheating of the metal, caused by the accumulation of a sedimentary deposit in the tube. Although the installation is provided with a water-softening plant, an inspection revealed the fact that the tubes adjacent to the ruptured one were more than half full of loose sedimentary deposit, and the removal of more caps disclosed the same condition in other rows of tubes.

In his observations the Engineer Surveyor-in-Chief states that the owners had gone to a great deal of pains and expense to ensure a pure boiler feed. More frequent "blowing down" might have been advantageous, and visual inspection should have been made with sufficient frequency to ensure that the tubes were clean.

New Power House at Whitwood Collieries.—The article which appeared under the above title in our last issue included an illustration of a 500-kW G.E.C. rotary converter, which, by an inadvertence, was stated to be a "2,000-kVA, 3-phase, G.E.C.-Fraser & Chalmers turbo-generator."

Electricity from Peat.

By W. A. PERRY.

As several references to peat have appeared recently, it has occurred to the writer that it might be useful to draw attention to one way, that has recently come under his notice, of utilising the immense deposits in Great Britain, which total approximately 3,500,000 acres, excluding Ireland; taking an average depth of 10 ft., this equals 40,000 million tons of wet peat. Some authorities give more than this, one giving as many as 6,000,000 acres in Great Britain and a further 3,000,000 acres in Ireland.

It will be admitted that, once a sound method is discovered of economically using this store of fuel, power stations can be erected to supply *cheap* electricity in bulk.

In view of the great advance in recent years of high-pressure transmission, the precise location of the deposits is of little importance and, given sufficient power, a great part of Great Britain could be supplied, large areas being fed from each centre. With our lack of water power, such an arrangement would go a long way toward conserving our resources of coal.

It is not possible to discuss peat without referring to its "chronic wetness." When it is borne in mind that water was a great factor in the formation of peat, it is not surprising that the latter is often found either under water or in immediate contact with it. Wherever the elevation will permit, drainage is found to be the cheapest way to remove most of the free water. Parallel cuttings are made at right angles to each other, leaving the peat to drain naturally, but it is seldom possible by this means to bring the water content much below 80 per cent. by weight. The tenacity of peat for the water contained in it is remarkable, and is the chief difficulty in utilising it commercially.

By pressure alone the moisture content has not been reduced much below 70 per cent. by weight, although pressures up to several tons per square inch have been used. In any case, it is only the *free* water that can be pressed out, as most of the rest is locked up in the cellular structure.

Another factor that must be taken into account is the cost of excavating. To win one ton of (dry) peat, ten or more tons, having a moisture content of 90 per cent. to 95 per cent. must be excavated. On the Continent it is still possible to cut by hand one metric ton of peat for a few pence. In Great Britain, however, we could not hope to win peat with 90 per cent. moisture with even the most up-to-date excavating machinery at less than a shilling per ton, which would be ten shillings for *dry* peat.

It is remarkable that nearly all the methods for getting rid of the remaining water have been designed to employ *heat*, and these were, of course, doomed to failure, as the peat hardly contains sufficient heat-units to evaporate its contained water. Air drying is slow and monopolises a large area, so that small quantities only can be handled.

The only direction in which any promising results have been attained is in breaking down the cellular structure of the peat to permit of the water being removed by pressure. Unfortunately, all the proposals which have been tried of this kind have failed in two particulars; they have neglected the heat economy, and the ultimate products have not been of sufficient value to pay expenses.

The process which is the subject-matter of this article appears to me to avoid these errors. After mechanical pressure the peat is hydrolised in an astonishingly simple manner, furfural, guaiacol, and methyl alcohol being recovered.

It is then pressed again between rolls, the squeezed-out saccharine liquor being fermented and distilled for ethyl-alcohol.

After disintegrating the solid residue and mixing it with a small percentage of coal dust (which it is said may be either pit-mouth refuse or waste riddlings from coal yards), the mixture is again pressed between rolls into irregular lumps and passed into a distilling-producer, which is also of very remarkable design. The resulting distillation products include methyl alcohol, oils, sulphate of ammonia, and about 100,000 cu. ft. (per ton of peat) of power-gas, of a calorific value of about 300 British thermal units per cubic foot, the bulk of which will be available for power. It is estimated that the profit from the by-products alone will be very large, and hence the cost of gas to the electricity department will be negligible.

Although this process has not been put into commercial use, I am informed that it has been exhaustively tried in the laboratory on a large scale, and has fully satisfied eminent engineers and chemists.

The thermal efficiency of the whole process appears to me good and, as there is said to be absolute continuity of the whole operation, and the labour required consequently is small, it should prove a profitable undertaking.

The writer understands that it is shortly to be tried on a commercial basis and, should it keep up its laboratory standard, we may soon see large central stations sitting on peat bogs supplying the country with cheap power.

Some New Electrical Terms.

By C. TURNBULL.

In his very interesting "Introduction to Mathematics," Dr. Whitehead speaks with contempt of a certain type of minor intellect that is always worrying about the applicability of technical terms. He contends that technical names are like Christian names for children: they serve to designate the individuals, but need have no relation to the qualities of the bearers. "I pay them extra and make them mean what I like," a principle enunciated in "Alice in Wonderland," serves as his summing-up of the whole matter. This from Dr. Whitehead is very disconcerting, and one may be forgiven for preferring his other words that "When the initial statements are vague and slipshod, at every subsequent stage of thought, common sense has to step in to limit applications and to explain meanings." He might have gone beyond this and have asserted that in such circumstances many people remain in the grip of the slipshod statements and never get clear ideas at all!

It is most important in technical engineering to avoid words which convey wrong impressions. Probably half the difficulty in learning mathematical engineering is due to the vague and slipshod manner in which most of our text-books enunciate the fundamentals. The conscientious learner reads over the text-books and tries to follow the literal meaning of the words without ever getting to the point that the words do not mean what they seem to mean, and he finally gives up the struggle in the belief that maths. is altogether too difficult for the practical man.

The term "electrical condenser" provides an example which is misleading. If it means anything, it means that the condenser has the power of condensing electricity. It does nothing of the kind. One might as well call the steel bottle that holds compressed oxygen, an oxygen compressor! The steam condenser certainly has the power to change tenuous steam into relatively dense water, but the electrical condenser is just a container, like the oxygen cylinder. The most appropriate word for condenser seems to be "capacitor," a word which goes well with "capacitance." We might also speak of the "capacitate" of a charged capacitor, this being the quantity of electricity which would flow if the capacitor were short-circuited. The word "capacitate" is analogous to condensate, and should be equally useful.

The term "choking coil" might be replaced with "inductor," which goes with inductance. Unfortunately, the word "inductor" has other meanings, but this difficulty might not be insuperable. Reactor is

now being used for this purpose, but reactor might be very useful as a word applying either to a condenser or a choking coil. We use the words "capacity reactance," and "inductive reactance" (Dr. Drysdale may be quoted for this), and it would often be convenient to be able to use "reactor" for that which causes phase displacement of current, whether leading or lagging.

Perhaps the proper authorities will take up these and similar questions and lay down rules which will clear up the present terminological inexactitudes that cumber our generally admirable electrical vocabulary.

Note.—Some critics may point out that in my power-factor essay I used the word "current" instead of "electrical energy," and on this they may dispute my right to suggest accurate electrical terms. To these I must reply that the word "current" is commonly used in this sense in the business circles for which the essay was written; indeed, some large power companies, in their agreements, use the expression, "electrical energy, hereinafter termed current." It is open for anyone to speak of electrical energy in dealing with business men, but, on the whole, it will be found that they prefer the word "current."

Those Delayed Deliveries.

By T. J. B.

There has recently been a renewed outburst of indignation anent the discrepancies between promised and actual deliveries of electrical plant. Naturally, the most indignant correspondents were buyers, and although, according to American belief, the customer is always right, in some cases the purchaser of electrical plant is responsible for much of the delay to which he so strongly objects. When the order covers, say, a standard motor, the purchaser sends in his order and has nothing more to do but await delivery and eventually pay, but if the apparatus in question has to be built to his requirements, the causes of delay in delivery start the day the order is made out. Consider an order for a switchboard for a small works power station, and follow progress from the word "go."

In all probability the original inquiry was somewhat vague. When the order comes in the engineer handling the job will sort out matters as far as possible, issue preliminary instructions to the drawing office, and start worrying the customer for particulars. Probably the first letter will say, in effect:—"We propose to supply instruments having the following readings, and current transformers ratio so-and-so. Comments please. We require the type and size of all cables to be used, particulars of field currents, size of field regulators which we have to mount, and label readings required. It is now your move."

After a death-like silence of a week or two the customer may write giving a few driblets of information, but meanwhile drawings cannot be completed, and half the items on the board cannot be put in hand. Eventually sufficient information is obtained to complete the drawings, and they are submitted for approval.

About this time the customer's engineer goes on holiday, but in ten days or so, with luck, the manufacturer gets a letter to the effect that the arrangement shown appears to be generally in order. No definite approval, of course, as that would commit the customer. Manufacture starts, and work is proceeding smoothly, when another letter comes in, saying: "On looking further into your drawing, I find I shall require the order of the panels reversed. Please arrange accordingly. Delivery of this board is almost due, and I shall be pleased to learn when you will dispatch." Altering the order of the panels is, of course, mere child's play; it only involves complete alteration of the framework details, and scrapping all the ironwork which has been cut up and drilled. The customer gets his delivery promise, a revised drawing, and the manufacturer's mental blessing.

Manufacture is now in full swing, so that a strike in some essential industry causes no surprise. The delivery date flashes by like a Bank Holiday, and the customer starts the usual threats of remembering this matter when next placing an order.

Eventually the job is finished, after weeks of overtime pay have destroyed all chance of a profit. The customer's engineer comes to inspect the board, and mentions casually on leaving—"So-and-so have let us down with the steam plant, so there is no hurry to send off the gear. I don't want a lot of cases standing about in the damp." The manufacturer quietly pushes him across the terminals of the testing transformer.

An order for switchgear has been considered, but the same remarks apply generally to any class of plant in the design of which the customer is involved. When tendering, the manufacturer knows that considerable delays for which he cannot be responsible will occur, but if he takes these delays into account in estimating his delivery date, the customer will usually place the order with a firm which gives a better promise, other considerations being equal. Some firms promise deliveries which, in theory, they ought to be able to keep; others, with more conscience, quote a date which appears absurdly long, but which they know from experience will be quite short enough. The short-date firms get a lot of new customers, and hope the delayed delivery will be forgotten when another order is to be placed. Buyers of electrical plant can help by placing orders well in advance of requirements, and by providing promptly all the information required for manufacture.

Penalties for delay in completion are not favoured by manufacturers, who know how many things may cause delay, and purchasers rather suspect that prices for penalty jobs include a certain percentage to cover possible delay in completion.

Manufacturers don't like long delivery dates, but naturally prefer to get work out and money in. Buyers don't like delayed deliveries either—doesn't it seem reasonable that the two should work together more?

Electrical Trade of France.

The following statistics of France's import and export trade in electrical machinery and apparatus have been extracted from the latest official monthly record, which deals with the complete twelve months. Full details regarding countries of origin and destination are not given. The import figures represent goods entered for consumption, the values being declared values. The export figures represent the Customs Commission's valuations. The increased shipments of electrical apparatus are remarkable, but it will be noticed that imports of dynamo-electric machines still exceed exports.

Imports.

	1922 Thous. francs.	1923 Thous. francs.	Inc. or dec. Thous. francs.
Dynamo-electric machines.—			
Weighing 1,000 kg. and over ...	28,600	31,200	+ 2,600
From 50 to 1,000 kg.	7,800	8,400	+ 600
Less than 50 kg.	8,800	10,400	+ 1,600
Electrical and electro-technical apparatus.—			
Wound with insulated wire ...	18,700	30,200	+ 11,500
Not wound with insulated wire	10,200	13,800	+ 3,600
Insulated wire and cable	1,100	2,900	+ 1,800
Commutators and parts	4,200	8,100	+ 3,900
Arc lamps and parts	40	30	− 10
Accumulators and parts	5,200	4,000	− 1,200
Dry cells	80	80	—
Incandescent lamps.—			
Carbon filaments	120	230	+ 110
Metal filaments	28,400	30,000	+ 1,600
Without caps	500	800	+ 300

Exports.

	1922 Thous. francs.	1923 Thous. francs.	Inc. or dec. Thous. francs.
Dynamo-electric machines ...	24,800	32,800	+ 8,000
Electrical and electro-technical apparatus	84,500	116,000	+ 31,500
Insulated wire and cable	43,700	36,700	− 7,000
Commutators and parts	8,300	14,000	+ 5,700
Incandescent lamps	15,500	23,400	+ 7,900
Arc lamps and parts	90	180	+ 90
Accumulators and parts	2,700	2,600	− 100
Dry cells	1,200	2,300	+ 1,100

Electrolytic Oxygen and Hydrogen Plant.

The Knowles Column Cell.

It is said that plant manufactured on the Knowles system for the generation of oxygen and hydrogen gases by the electrolysis of water has been installed in this country and abroad of an aggregate capacity of over 100 million cu. ft. of hydrogen per annum.

The original batteries were supplied to Messrs. Lever Bros., Ltd. (who have one of the largest installations in this country and three abroad) and have operated successfully at a small upkeep cost for about 10 years. Some three years ago the International Electrolytic Plant Co., Ltd., of Chester, obtained the sole manufacturing rights under the Knowles patents, and has since supplied plant to Messrs. Loders & Nucoline, Ltd., of Silvertown; the Osram-G.E.C. lamp works (which installation will be working shortly); the Southern Oil Co., Ltd., of Trafford Park (the English offshoot of the American Southern Cotton Oil Co., which has at its works in the United States, electrolytic cells of almost every known make); two installations for the Uralplatina in Russia; and a battery of 104 cells in series at the Erith Oil Works, Ltd. (fig. 1). The improvement in design is indicated by the fact that the cells at Erith have only 14 electrodes in each, against 42 in the original cells at Port Sunlight; thus the floor space occupied has been reduced to one-third without materially increasing the electrode current density. The Erith plant has a guaranteed maximum output of 2,625 cu. ft. of oxygen and 5,250 cu. ft. of hydrogen per hour when using 3,000 amperes at 2.5 volts per cell, the purity test result being 99.6 per cent. in the case of oxygen, and 100 per cent. in that of hydrogen.

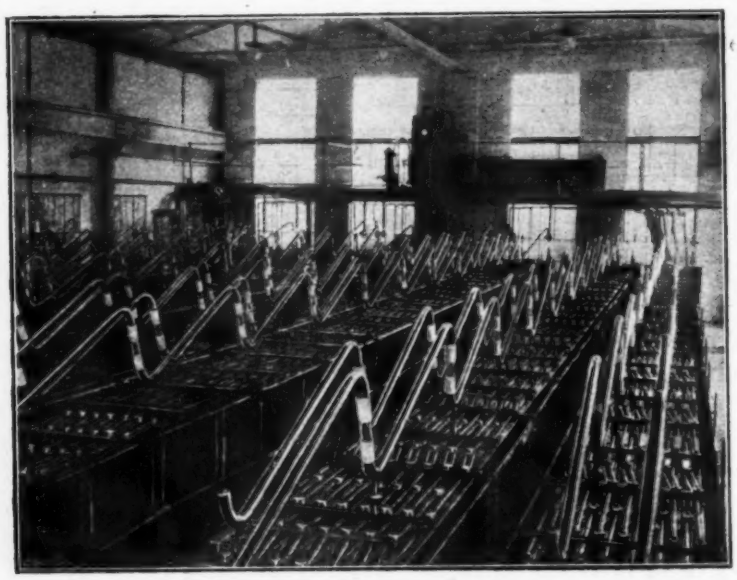


Fig. 1.—A Battery of Knowles Electrolytic Cells at Erith.

The International Co. has in hand at the moment a 160 cell battery, which is being manufactured in the works of its subsidiary company in Italy, and will be installed in Southern Italy for producing hydrogen to be used in the manufacture of synthetic ammonia. From the electrical point of view this installation is of considerable interest, inasmuch as it will utilise during the off-peak periods the surplus energy from the generating station that supplies Naples, and the cells have been designed to run at any current between 2,000 and 7,200 amperes, depending upon the amount of surplus power available.

We believe we are correct in stating that this is the first electrolytic plant that will make use of surplus electric power in this way; the installation is being supplied to Elettrochimica, of Rome, which has an option on ten sets of similar plant, and expects to place the order for the second installation shortly.

The Knowles multipolar cell consists of an electrolyte tank in which are suspended alternately anodes and cathodes, each covered by a gas-collecting bell. Alternate plates in each cell are connected in parallel, and copper links at both ends of the cell couple each set of electrodes in series with those of opposite polarity in the cells at both ends. The number of cells employed is controlled by the supply voltage, and the number of bells per cell by the current necessary at the available voltage to produce the output of gas required. Asbestos diaphragms separate the electrodes and effectually prevent mixing of the gases. Each electrode and collecting bell is a complete unit it itself, but all the bells in one cell are rigidly connected together and may be lifted from the cell, complete with connections, in one operation.

Current is led to the electrode plates by staggered bolts with terminals on the tops of the bells, from which oxygen and hydrogen are carried off by two pipes. The gas evolved carries with it a certain amount of electrolyte in the form of a fine spray; this is collected in the off-take pipes which are of a special form to assist in returning it to the cells. Each bank of cells is supplied with distilled water flowing by gravity, the inlet to the feed tank being controlled by a ball valve so that the level of the electrolyte remains constant, independently of the quantity of gas being evolved. The electrolyte consists of a 15 per cent. solution of the highest quality caustic soda in pure distilled water; once a solution of the right strength is made up, the only addition required is distilled water, but it is of the utmost importance that this shall be absolutely pure, as the durability of the cells is very largely dependent on the quality of the water supplied to them.

The latest pattern of Knowles cell, while incorporating all the best features of the original type, has been designed with a view to economising the floor space occupied by large installations—an important consideration in the housing of such plant—and the superimposed arrangement is claimed to be entirely novel.

For the sake of clearness, fig. 3 shows only two cells, but in practice the cells can be erected ten high. The current passes directly from each cell to the cell above, without any external connections, the polarity being reversed as it passes from one cell to the next, and the only electrical connections required are to the bottom of the lowermost and to the cover of the upper cells of each column. Upstanding electrodes A on the base of one cell alternate with electrodes B hanging from the base of the cell above, and form the anodes and

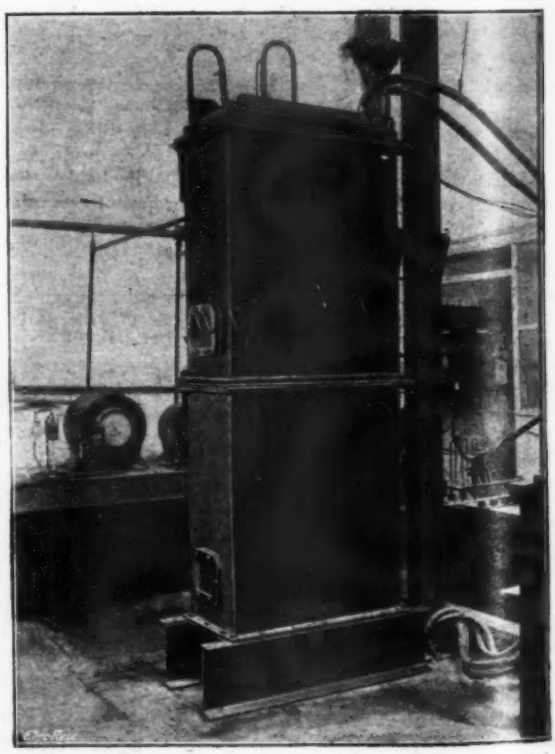


Fig. 2.—Column Cells on Test at the Chester Works.

cathodes respectively of each cell unit. Asbestos diaphragms C suspended from the dividing or bell plate D surround the hanging electrodes and prevent the gases which collect in the spaces E and F from mixing. The containing tank, the inner surface of which carries an electrode, is built up of four iron castings bolted together, and is of rigid construction to carry the weight of the cells above. All the tanks in any particular plant are identical and interchangeable, so that any tank may be used for the bottom cell without risk of failure from the weight above. The base of the tank to which the electrodes are fixed rests on the projection G and is bolted to it to form an electrolyte-tight and gas-tight joint. Suitable electrolyte separators and vertical gas offtake pipes are coupled to H and J while make-up water is fed to the cells through K. The tanks of adjacent cells are insulated from one another by special jointing rings L which also form a gas-tight joint and insulate the bell plate from both the tank above and below it. There is no possibility of a short circuit occurring between adjacent tanks, as any electrolyte which may drip from a faulty pipe connection on the cell above falls clear from the projecting flange M when it reaches the bottom of the tank. Due to the weight of the cells and electrolyte, no holding-down bolts are necessary to make the joint between the tanks gas-tight, and erection or dismantling therefore simply consists in lifting one cell complete with electrodes from the cell below. Straight copper bars N bolted on both sides of lugs extending the whole length of the electrodes carry the current between the top and bottom cells of adjacent columns.

The design is simple and does not involve the use of any material liable to rapid deterioration. The anodes, which in one column are the upstanding electrodes and in the next the depending plates, are treated with nickel by a special process which is claimed to ensure entire freedom from corrosion and also to reduce over-voltage. The asbestos diaphragms should have a life of not less than five years, and material of lasting qualities and high insulation properties in the presence of caustic soda is used for the joints between the cells and the base plate and tank; the tank walls carry no current.

In addition to the saving in floor space, the Knowles column cell is said to have a low current density and small depth of electrodes, which check corrosion, whilst the smaller number of clamped joints and copper connections used tends to

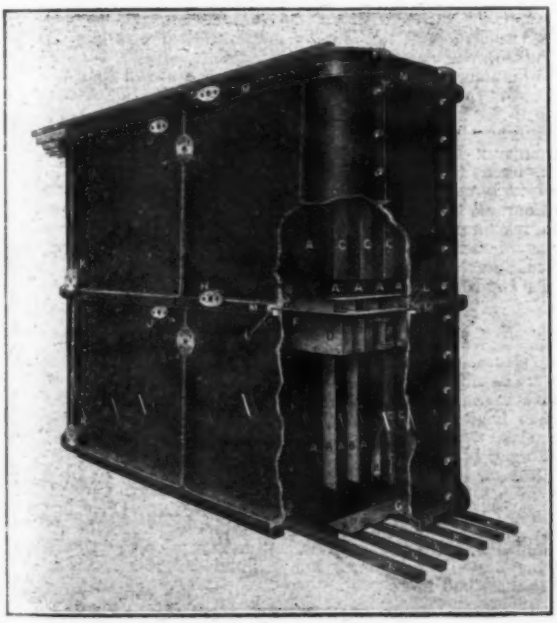


Fig. 3.—Knowles Superposed Cells.

reduce the C^2R losses. Normally the cells operate at 2.25 volts per cell, but the flexibility indicated by figs. 4 and 5 is of importance when such plant is used in connection with off-peak power schemes when the power available varies considerably during the day.

Safety devices are incorporated so that if an abnormal increase of pressure occurs in one or both of the offtake pipes, the gases blow to atmosphere and cannot mix through the asbestos diaphragm. In the event of the level of the electrolyte in the cell falling, hydraulic seals on both gas offtake pipes are broken and the gases are released to atmosphere before the electrolyte level falls to the top of the diaphragms; therefore only practically pure gases can pass into the offtake pipes, but purifiers can be added to give 100 per cent. pure gases.

Before the gas is passed through the purifiers traces of electrolyte are washed from the gas in its ascent through scrubbers packed with hard coke by a descending stream of water. The hydrogen or oxygen is then passed through a furnace over a heated catalyst, and the impurity (consisting of a very small percentage of the other gas) is ignited to form water vapour. The furnace is designed on a reverse current system, so that the hot gas leaving it heats up the cold incoming gas. The action is started and maintained by means of an electrically-heated resistance inside the furnace cover, the temperature being controlled by a variable rheostat

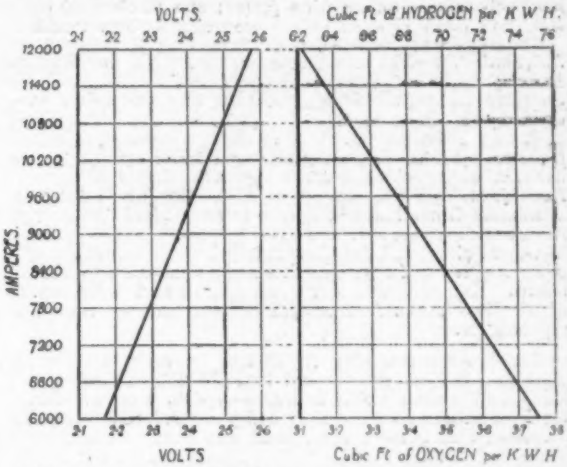


Fig. 4.—Current/Voltage Curve.

Fig. 5.—Current/Gas Curve.

and indicating pyrometer on the switchboard. Slag wool is packed between the furnace and outer case to conserve the heat evolved and render the action largely self-supporting, the current used being small and in practice, once the action has been started, the heating coil may often be cut out altogether.

Parliamentary.

[By Our Special Parliamentary Reporter.]

West Indian Cables.—On March 31st, Mr. J. H. Thomas, Colonial Secretary, moved the West Indian Islands (Telegraph) Money Resolution which authorises the issue out of the Consolidated Fund of £400,000 for providing a system of telegraphic communication in and with the West Indian Islands and British Guiana, by means of submarine cables and radio-telegraph stations. He explained that at present the Government was under a ten years' contract with the West India and Panama Telegraph Company, which expired this year. There were certain objections of a fundamental character to the existing system, but in any case the fact that the contract expired this year enabled the Government to reconsider the whole position. So unsatisfactory had been the service that notwithstanding a yearly subsidy of £26,000, there was at present a deficit on the working. The object of the Bill, which would be founded on the resolution, was to provide a new scheme. He believed that, viewed from the most unfavourable point of view, the maximum deficit under the new scheme would be £20,000 per annum. The Marconi Company had nothing to do with the scheme. The whole of the cables would be working in June and the principal radio station would be at Barbados. The firm which was laying the cable was Messrs. Siemens Bros. & Co.—The resolution was agreed to.

Short-Wave Radio-Telegraphy.—On April 1st, Sir Harry Brittain asked the Postmaster-General if his department had any information as to Senator Marconi's recent work in short-wave directional transmission of radio telegraphy; and whether, seeing that this system greatly reduced the initial and operating costs of stations while securing a much higher speed of transmission, the stations which the Post Office was erecting were so planned as to permit the use of the new system.

Mr. Hartshorn said that the Post Office experts had been cognisant of these experiments during the last five years, but there was no evidence at present that the system was capable of maintaining regular and efficient communication of the continuous character required in a commercial service. So far as was known, it had not been tested over the long distances covered by the Empire scheme. If and when the system was developed, it might conceivably have the advantages suggested, but it would have the serious disadvantage of destroying the elasticity of radio communication, which permitted of stations being allocated to different lines of communication according to the varying exigencies of the traffic. As a matter of fact, the Post Office station which was being

erected at Rugby would be adaptable to the use of the system should this be considered desirable later.

Automatic Telephones.—On April 1st, Mr. Hogge asked the Postmaster-General whether he could give the names of the firms to whom the contract for installing automatic telephones in this country had been given; whether he could state the proportions in which the contracts had been given to the different firms; whether such firms had been granted a monopoly and, if so, for what period; and whether he could state how many of these firms were under American control.

Mr. Hartshorn replied that the firms in question were the Automatic Telephone Manufacturing Co., Ltd., the Western Electric Co., Ltd., Siemens Brothers & Co., Ltd., and the Coventry Automatic Telephones, Ltd., and the orders were divided between them in the proportion of approximately 8, 4, 2, and 1 respectively. The agreements with these manufacturers provided that the plant required for equipping London Exchanges with automatic apparatus should be ordered from them until the summer of 1926, after which date the Postmaster-General was at liberty to order plant of this type from any manufacturer. All these companies were registered in Great Britain and the plant supplied would be, with negligible exceptions, if any, manufactured and installed by British labour. He understood that a considerable part of the capital of the two first-named companies was held by American shareholders.

Postal Accounts.—On April 1st, in reply to Sir H. Brittain, Mr. Hartshorn said that the 1923-24 surplus and deficits on various postal accounts were as follows:—Postal services, including money order and postal order business, but excluding Post Office Savings Bank and Government annuity business, estimated surplus for 1923-24, £5,093,000; telephones, estimated surplus for 1923-24, £1,543,000; telegraphs, including radio-telegraph services, estimated deficit for 1923-24, £1,236,000. The estimated deficit in connection with the Post Office radio stations was £43,000, which was included in the telegraph deficit.

The Recent Transport Strike.—On April 3rd, Mr. Hughes asked the Prime Minister whether, in view of the inconvenience, loss and suffering caused to the public in the London area during the recent strike by the stoppage of tramcars and omnibuses, he proposed to take steps, by legislation or otherwise, to prevent the recurrence of such a state of affairs, and why the Government did not provide protection for the general public during this recent strike by organising a service of transport.

Mr. Clynes, who replied, said the Government was convinced that disputes of this kind not only could not be prevented by means of legislation, but that any attempt in this direction could not fail to be disastrous. As regarded the second part of the question no course other than that which it adopted would, in the Government's opinion, have assisted in securing the settlement which was reached by agreement between the parties to this dispute. The Government's handling of the dispute saved the London public much inconvenience and disturbance.

London Traffic Bill.—This Bill was considered by a Standing Committee of the House of Commons on April 3rd. An amendment to limit to the County of London the operations of the Advisory Committee which is to be set up to assist the Minister was moved by Sir J. F. Remnant. Mr. Gosling, the Minister of Transport, opposed the amendment, which he said was a thrust at the principle of the Bill. The area proposed (within a radius of 25 miles of Charing Cross) was a very necessary one to adopt.

Mr. Percy Harris, in supporting the amendment, said that if they had an ideal authority for the County of London, and could get a traffic system for the tramways, omnibuses and taxicabs which used the streets of London, they would have gone a long way towards finding a solution of the problem. Eventually the amendment was negatived, as was another amendment to limit the operation of the Bill to two years after its passing.

The Committee then adjourned.

Engineer Emigrants.—On April 3rd, Mr. Penny asked the Minister of Labour whether he could supply any statistics of skilled engineers who had left this country in the past year to take up work in the United States of America and other countries.

Mr. Webb said that the classification of emigrants according to their occupations had been completed only for the first nine months of last year. During that period the number of British emigrants, of 18 years of age and upwards, who left the United Kingdom for non-European countries and who were classed as "Skilled Trades—Metal and Engineering," was 20,509, of which number 12,207 were taking up permanent residence in the United States of America.

Insulation of Electric Wires.—On April 3rd, Mr. Remer asked the Postmaster-General whether, when issuing schedules for silk-covered wires, he would specify that, in view of the great amount of unemployment in the silk trade, only British net silk for insulation of electric wires should be used.

Mr. Hartshorn replied that Post Office tenders stipulated that, in all cases involving the use of silk, "if natural silk is to be used . . . only British spun silk shall be used."

The Wakefield Corporation Bill.—When this Bill came before a Committee of the House of Lords on April 1st objections were raised to a clause giving the Corporation power to purchase and sell or hire lamps, electrical installations, fittings, motors, &c. Mr. Tyldesley Jones, K.C., for the Corporation, said that the power asked for was possessed by every company-owned undertaking, and the local gas company also had powers in this regard. There was nobody in Wakefield who was providing a proper showroom, and who was in a position to sell electrical fittings to the public. The city electrical engineer (Mr. H. G. Fraser) said that Mr. Robb's showroom in Wakefield was not so extensive as that which the Corporation intended to open. Alderman G. Foster said that a policy of co-operation with the contractors had been decided against by the General Purposes Committee. Mr. Rowland Harker said that although the Electricity (Supply) Act of 1919 did not encourage municipal trading, this was a special case.

Mr. H. G. Purchase, representing the Electrical Contractors' Association, repudiated the suggestion that there were no effective arrangements for the sale of electrical fittings in Wakefield; Messrs. Robb had a very extensive showroom. There were nine electrical contractors in the city. Mr. Walter Robb corroborated this, and said that the contractors in Wakefield had always been able to keep pace with the work which was going on; at least two-thirds of the consumers on the Corporation's mains were obtained by the contractors. Witness said that his was the only showroom; the price of energy was too high for general purposes.

Mr. L. G. Tate presented statistics relating to the electrical progress made by a number of municipal undertakings since 1911. These were designed to show that where undertakings possessed no trading powers (or, possessing them, did not use them), the rate of advance was much greater than in the case of undertakings carrying on trading in fittings and apparatus.

In conclusion, Mr. Harker said that although the contractors were willing that the Corporation should open a showroom, they wished to reap all the advantages.

The Committee decided that the clause should be omitted.

Legal.

Igranic Electric Co., Ltd., v. London Variometer Co.

In the Chancery Division on March 28th, before Mr. Justice Russell, counsel mentioned this action against the London Variometer Company, of Streatham. He stated that this was a motion for an injunction to restrain the defendant company until judgment in the action or further order from infringing the registered trade mark of the Igranic Electric Company, Ltd., and from selling or offering for sale electrical apparatus under, or in connection with, any circular, notice, or advertisement containing the word "Ivanic" or any other colourable imitation of the word 'Igranic"; from supplying in response to orders for "Igranic" apparatus other goods not of the manufacture of the Igranic Electric Company, Ltd.; and from otherwise passing off the plaintiffs' goods. His Lordship granted the injunction asked for.

Fraudulent Consumption of Electricity.

Two cases concerning the fraudulent consumption of electricity were heard at the Hull Police Court on March 31st. A cabinet maker was fined three guineas and costs for lighting his workshop from power mains. The Corporation's meter superintendent said that there was a lot of this sort of thing going on, and the authorities had difficulty in discovering the culprits.

The other case was that of a garage proprietor, who had run a light to a window sign, using the current from a charging board. Defendant did not think there was any harm in using the light which otherwise would have been wasted. He was fined three guineas for fraudulent consumption of current, and two guineas for laying a line without consent. In each case the costs had to be paid.

Employés' Compensation Under the Electricity (Supply) Act, 1919.

A dispute over the right of employés of an electricity company to certain compensation under the Electricity Supply Act of 1919 came before Mr. Justice Bailhache in the King's Bench Division on March 31st.

The matter came before his Lordship in the form of a special paper on the motion of the Chelsea Electricity Supply Co., Ltd., to set aside an award of an arbitrator made in favour of employés who had claimed the compensation.

Mr. Jowitt, K.C., for the company, explained that on September 20th, 1921, the Chelsea Electricity Supply Co. and the Central Electric Supply Co. made an agreement by which the former was to be supplied with electrical energy by the latter. As a result of the agreement the generating station of the Chelsea Co. was gradually shut down, and in the latter part of April, 1923, a number of employés received notice of dismissal. Without admitting any liability to pay compensation and without any previous request from those employés the company paid certain amounts to the employés they had dismissed. At a later stage the trade union side

District Council No. 10, Greater London Area of the Electricity Supply Industry claimed compensation from the company on behalf of all the persons dismissed. It was contended that they were entitled to compensation under Section 16 of the Electricity Supply Act of 1919 because they had been dismissed otherwise than on the ground of misconduct, incapacity, or superannuation. Compensation, on the same ground, was also claimed on behalf of certain employés who had suffered diminution of wages. These claims were upheld by a Referee appointed by the parties.

After hearing legal argument his Lordship upheld the Referee's award, which was based on the grounds that the agreement was not only made under the Acts of 1908 and 1910, but also under that of 1919. He therefore thought that the employés were entitled to compensation at the rate provided for in the last Act.

B.T.-H. Litigation.

Mr. Justice Tomlin, in the Chancery Division on April 2nd, delivered judgment in the actions by the British Thomson-Houston Co., Ltd., against Sterling Accessories, Ltd., and Crowther & Osborn, Ltd., and their individual directors, for injunctions restraining infringement of plaintiffs' letters patent for inventions relating to the treatment of tungsten. (*Vide* our last issue, p. 559.) It was not alleged that the directors were actually responsible, but it was contended that the company was only a cloak under cover of which the infringements were committed by the directors or that the defendant company was the agent of the directors to commit the infringements. Secondly, it was said that the true inference from the facts was that the directors authorised the acts of infringement. There was no evidence, said his Lordship, pointing to the relation of principal and agent having been established between the directors and the company unless the fact that the directors were the sole directors and shareholders could be properly regarded as a circumstance from which the relationship ought to be inferred. He did not think that any such inference could, or ought to be drawn. It had been made plain by the House of Lords that to establish contractual liability it was not possible, even in the case of a one-man company, to go behind the legal corporate entity of the company and treat the creator and controller of the company as the real contractor merely because he was the creator and controller. If a director was to be fixed with liability as principal the agency of the company must be established and could not be inferred from the holding of the contractors themselves and the control of the shares. Any other conclusion would nullify the purpose for which the creation of a limited company was authorised by the legislature. He thought, therefore, that the plaintiffs' first contention failed. As to their second contention the answer must be that there was no evidence from which it could be or ought to be inferred that the defendant directors had authorised the wrongful acts of the company. To draw that inference from the fact that they were the sole directors and shareholders of the company would manifestly be wrong. It followed, therefore, that the plaintiffs' second contention failed, and the result was that the action succeeded against the company but failed against the directors, and must be dismissed with costs.

With regard to the second action the patent was the same and the defendants made the same admissions. The plaintiffs relied for their facts upon an agreement between the defendant company and the Electrical Contractors' Association of Scotland, and signed by the defendant directors. This document contained a guarantee by the defendant company that the lamps sold to the Association did not infringe any existing patent, and an indemnity against claims for infringement. But he was unable to see that it had any bearing on the question of liability of the directors, and the plaintiffs' case received no support from it. The result would be the same as in the first case, except that a counterclaim for revocation would be dismissed with costs.

Mr. Trevor Watson intimated that there might be an appeal.

British Thomson-Houston Co., Ltd., v. British Insulated and Helsby Cables, Ltd.

The hearing of the appeal of the defendants in this case was resumed on April 1st.

Sir Duncan Kerly, continuing his case for the appellants, said that in 1913 the respondents commenced an action against Duram, Ltd., for the alleged infringement of their 1906 patent. Mr. Justice Astbury decided that the patent was invalid, and his decision was confirmed by the House of Lords. The invalidity of the patent was decided on a contention by the defendants in that case that the claims made were too wide and that they covered a principle and went far beyond anything which was subject matter. The Judge had held that the application of the metal-worker's art to a metal could not be covered by a patent. An endeavour to amend the patent failed, and the respondents produced the 1909 patent—the same inventor and the same patentees.

Respondents now said that the real invention was to be found disclosed in the patent of 1909—nearly everything Sir Arthur Colefax had said on the last occasion before Mr. Justice Russell was what he had said in opening the case on the 1906 patent, only in different words. The Scotch decision was under appeal to the House of Lords, and it was possible that that case would get there before the present case. He (counsel) submitted that if the respondents' present case was true, the 1906 patent was a fraud. It purported to give an account of a process and the result of the process. Now the 1909 patent treated the 1906 patent as the starting ground. The 1909 patent, in effect, said: "I have made a further discovery. I have discovered that if you keep on working your tungsten wire it will ultimately become ductile cold." But that would not give the 1909 patent subject matter, and appellants' case was that there was no subject matter for that patent.

Sir Duncan Kerly occupied a considerable time in reading the judgment of Mr. Justice Russell and commented upon his Lordship's findings of fact upon the evidence. Dealing with the question as to the temperature of working, Counsel contended that any metal worker could by working under the 1906 patent produce tungsten ductile cold and could ascertain the proper temperature of working and the proper steps for reduction. He submitted that the 1906 patent did disclose the 1909 invention and that the Judge had misdirected himself on the issue as to subject matter of the patent of 1909. What the Judge had done was to justify subject matter by one test and to disregard it on the issue of infringement by another. He (counsel) submitted that that was wrong.

The Court, on April 7th, delivered its reserved judgment on the legal point raised as to whether the appellants were entitled to read evidence given in the previous action.

The Master of the Rolls stated that Mr. Justice Russell had refused his permission to admit the evidence, and after reviewing the law on the point, said that he agreed that the application must be refused.

Lord Justice Atkin concurred and Lord Justice Sargant dissented.

(To be continued.)

H.M. Inspector of Factories v. Lithgow, Ltd.

This case, in which the defendants were prosecuted for an alleged breach of the regulations governing the use of electricity in a dockyard, resulting in the death of a workman, was resumed at Greenock Sheriff Court on April 2nd. An adjournment had been made at the defendants' request to enable a foreman to be included in the charge (*vide* our last issue, 559). The foreman was present, but his legal representative objected to his inclusion in the charge on the grounds that there was no authority in Scotland for a prosecution at the instance of the employers, and that the statutory time limit within which the charge could be brought had expired. The Sheriff ruled out the first objection and, as to the second, pointed out that a plea was not necessary until fault had been established against some one. The case was again adjourned.

Marconi's Wireless Telegraph Co., Ltd., v. Mullard Radio Valve Co., Ltd.

Judgment was delivered in the House of Lords on April 7th, by Lords Cave, Dunedin, and Buckmaster, in the Marconi-Mullard Valve Co. litigation, the Marconi Co. having appealed against a decision of the Court of Appeal which affirmed a finding of Mr. Justice P. O. Lawrence that the Mullard Co. had not infringed the Marconi patent for Round's invention of 1913 of "Improvements in Receivers for use in Wireless Telegraphy." Their Lordships upheld these decisions, and dismissed the appeal with costs.

Lord Dunedin, having made a critical examination of the patent, said that unless fair protection was given to patentees, research was crushed in the bud, and with it all the eventual benefit to the public which research brought. What Round claimed as his invention was an apparatus in which the filament was enclosed in a closed cylinder, that is to say, a cylinder geometrically closed at the ends. Soft valves were the only valves he knew. Soft valves permitted of ionisation, and ionisation had bad effects when the glass was electrified by being exposed to the cathode stream. Round diagnosed the disease and set himself to cure that disease by a remedy of a particular form. His own explanation seemed to his Lordship to be conclusive. He did not claim as a new arrangement a vacuum tube containing a hot filament, a grid, and a third electrode. That had been already invented, and all that was left was either the addition of something new or a novel arrangement of what was old. Round said:—"The grid and the third electrode are, according to this invention, made in the form of closed cylinders which completely surround the hot filament." And he then gave the result. "These cylinders effectually protect the glass from electrification." The glass could not be protected from electrification unless the filament was completely enclosed. Therefore it seemed to his Lordship impossible to read the word "closed" except in its ordinary and natural meaning, physically or geometrically closed. The appellant argued that closed might mean "electrically closed." This expression had no recognised meaning, for it was not used in the simple meaning of the closing of an electrical circuit, but was invented to express what the appellant conceived to be the meritorious arrangement of parts in his invention. If so, electrical closing ought to have been defined, and claimed.

Charge Against a Partner Fails.

Before the Common Serjeant (Sir H. F. Dickens, K.C.), at the Central Criminal Court, on April 4th, Donald Mackenzie pleaded "Not guilty" to a charge of stealing 706 insulators, the property of a partnership of which he was a member, also a bankers' cheque for £17 6s. 10d. He was also charged with obtaining credit without disclosing the fact that he was an undischarged bankrupt. Mr. Arthur Bryan appeared for the prosecution and Mr. F. Hancock defended.

Mr. Bryan stated that it was alleged that whilst an undischarged bankrupt the accused induced another man to enter into partnership with him and they carried on business as the Ebonite Radio Components. The defendant's partner was Mr. William Alfred Archer, a Fulham metal merchant. The prosecution alleged that 706 insulators which were ordered and paid for by the partnership were taken by the defendant, who sold them to the Edison Swan Electric Co. The cheque for the goods he paid into a separate banking account which had been opened in the name of the partnership without the knowledge of the prosecutor. The prosecutor found £100 for the partnership, and they were each to draw £5 a week. The partnership agreement also further stipulated that all moneys received in the business should be paid into the banking account of the firm. During the course of the trading a parcel of insulators was obtained, and when the prosecutor missed them the defendant told him that they had gone out as samples. As a matter of fact, the defendant had sold them to the Edison Swan Co. and had received a cheque in payment. It appeared that an action was brought against Ebonite Radio Components by the Edison Swan Co. regarding the insulators and the prosecutor then discovered what had happened. When seen by the police the accused said: "I knew Archer had a warrant out for me, so I kept out of the way as I expected a big deal to come off."

In reply to the charge defendant stated that he was introduced to the prosecutor in July, 1921. The prosecutor was made aware of his financial position as he always carried with him a newspaper cutting containing a report of his public examination in June, 1921. With regard to the money received from the Edison Swan Co., witness pointed out that the landlord of the Regent Street premises was pressing for the rent. He paid the rent out of his own pocket and when the cheque came from the Edison Co. he repaid himself.

Witnesses were called who stated that they were present when the prosecutor was introduced to the defendant in 1921. The Common Serjeant said that if the jury could not accept the evidence of the prosecutor relating to the charge against the defendant of obtaining credit without disclosing that he was an undischarged bankrupt then they could not very well accept it on the other matters in dispute. His Lordship pointed out that the defendant paid the rent out of his own pocket and was therefore entitled to recoup himself to that extent.

The jury stopped the case, and returned a verdict of "Not guilty." The Judge agreed with the verdict, and the defendant was discharged.

Business Notes.

Bankruptcy Proceedings.—M. C. Jones & Co. (a limited partnership), stockists of wireless parts and accessories, 239, Westgate Road, and 65, Thornton Street, Newcastle-on-Tyne.—Receiving order made March 27th, on debtors' own petition. First meeting April 14th, public examination April 24th, both at the County Court, Newcastle-on-Tyne.

G. F. Neal, electrical engineer, 5, Smallgate, Beccles.—First meeting held April 9th, at the Official Receiver's office, 8, Upper King Street, Norwich; public examination April 8th, at the Town Hall, Great Yarmouth.

V. G. Burkitt (V. G. Burkitt & Co.), electrical engineer, 38, Park Row, Bristol.—Discharge granted subject to debtor's consenting to judgment for £30 being entered against him. (The £30 has been paid and the judgment satisfied.)

L. A. Brown, electrician, The Street, Frensham, Surrey.—Last day for proofs for dividend April 16th. Trustee, Mr. T. Gourlay, 29, Russell Square, W.C.

P. Rukin, electrical engineer, Manchester Road Station, Bradford.—First and final dividend of 3s. 9d. in the £, payable at 69, Swan Arcade, Bradford.

A. W. Bould, electrician, 29, High Street, Skipton.—Receiving order made April 1st, on debtor's own petition. First meeting, April 11th, at the Official Receiver's office, 12, Duke Street, Bradford. Public examination, April 28th, at the County Court, Bradford.

C. F. M. Metcalf, electrical and wireless engineer, 8 & 10, Cow Green, Halifax.—Last day for proofs for dividend, April 19th. Trustee, Mr. C. H. Baker, 1, Albion Street, Boar Lane, Leeds.

Company Liquidations.—New Electra Sign Co., Ltd., 30, Bolsover Street, London, W.—Pursuant to Section 188 of the Companies (Consolidation) Act, 1908, a meeting of the creditors of the above was held recently at the offices of Messrs. Andrew W. Barr & Co., C.A., 1, Queen Victoria Street, E.C., when Mr. Tyler presided, and stated that the liabilities were approximately £1,250, and the assets amounted to about £570. It was reported that the company was formed in June, 1922, with a nominal capital of £2,500. For the period to the end of December, 1923, there was a loss made of £173. The gross profit was £2,373. After discussion a resolution was passed to the effect that application should be made to the Court for the appointment of Mr. E. H. Hawkins, of Messrs. Poppleton, Appleby & Hawkins, accountants and auditors, of 4, Charterhouse Square, E.C., as liquidator in the place of Mr. Tyler. Mr. Tyler stated that he was willing to resign his position, and would call a meeting of the shareholders to appoint Mr. Hawkins as liquidator to save the expense of going to the Court. The following are creditors:—

	£		£
J. K. Baughan	119	J. Fever & Co., Ltd.	295
Wm. Brown, Ltd. ...	37	— Holden	93
Parsons, Sherwin, Ltd. ...	415	Theodore Brown	57
London Lithograph Co.	138	R. B. Tyler	44
Haycock, Cadle & Graham ...	124	F. Turner	12
Siemens Bros. & Co., Ltd. ...	33	W. W. Rodgers	12

Wireless Installations, Ltd., 81, Turnmill Street, E.C.—Under the compulsory liquidation of this company a statement of affairs has been lodged showing liabilities of £3,899; assets valued at £834; and a total deficiency of £3,076 as regards contributories.

Mr. G. D. Pepys, official receiver and liquidator, reports that the company was promoted by Mr. and Mrs. Herbert Chas. Phillips in October, 1922, with a capital of £100, to carry on the business of manufacturing, assembling, and selling wireless receiving sets. A trading account which had been extracted for the purpose of the statement of affairs showed net sales of £15,156 and stock-in-hand at the date of winding-up to the value of £900 against purchases of materials, &c., £13,275, and wages £1,809, a gross profit of £972 resulting for the period. This result, excluding as it does all overhead charges, is a very poor one, and points to an error of judgment either in the buying of materials or of the price at which the sets were sold. The figure of £15,156 sales shown above is net after the sum of £2,067 loss to the company on sets returned has been deducted. In April, 1923, the directors were empowered by special resolution to create and issue a series of ten debentures of £100 each with interest at 7 per cent., and constituting a floating charge upon the whole of the company's assets. The special resolution was confirmed on May 2nd, and on the following day six of the debentures were issued to Mrs. Phillips in exchange for £600, which was thereupon paid into the company's banking account. The moneys in respect of the debentures were not repayable until September 29th, 1923, but in August certain creditors of the company were seeking judgment in respect of their claims and under the terms of the debentures Mrs. Phillips, in order to protect her assets, appointed Mr. John S. Bird to be her receiver thereunder. For a short time after the receiver's appointment he continued to carry on the business with a view to its realisation as a going concern, but soon after he closed the business down and disposed of the stock, &c., for the sum of £300. The failure and insolvency of the company is attributed by Phillips to the depression in trade. He also admits that the company was handicapped by the lack of skilled labour, which may, indirectly, have affected the failure. Mr. Pepys states that although the assets are valued at £223 after payment of the debentures, the receiver does not expect to recover the full amount from the book debts, and it does not appear likely that any surplus will result and be available for the unsecured creditors.

Springfield Electric Motors, Ltd.—Winding up voluntarily. Liquidator, Mr. V. Walton, 26 & 27, Bond Street, Leeds. Meeting of creditors April 14th, at the Hotel Metropole, King Street, Leeds. Particulars of claims to the Liquidator by May 31st.

Fleming, Birkby & Goodall, Ltd.—Meeting of creditors at 6, Harrison Road, Halifax, April 12th. Liquidator, Mr. B. Turney. This meeting is formal; the company is being liquidated for the purposes of amalgamation, and all creditors will be paid in full.

Radio Electrico, Ltd.—A meeting of members is called for May 1st, at 3, Broad Street Buildings, E.C., to hear an account of the winding-up from the Liquidator, Mr. A. W. Deering.

Geo. Airey & Co. (Electricians), Ltd.—A meeting of members is called for April 30th, at 57, Surrey Street, Sheffield, to hear an account of the winding-up from the Liquidator, Mr. J. Hancock.

Private Arrangements.—John Leitch, trading as the Marylebone Electric Fittings Co., electrical fittings manufacturer, 4, Ramillies Place, Oxford Circus, London, W.—The creditors interested herein were called together on April 4th, at the offices of Messrs. Corfield & Cripwell, accountants and auditors, Balfour House, Finsbury Pavement, E.C. The statement of affairs presented showed liabilities of £637, of which £449 was due to the trade, and there was a cash creditor for £120, whilst the bank was scheduled for £68. After allowing £18 for preferential claims the assets were estimated to realise £132, or a deficiency of £505. Mr. A. E. George re-

ported that the debtor originally commenced the business in January, 1919, with a partner. The joint capital was £850, of which the debtor found £700 and it was agreed that he should receive two-thirds of the profits. At the outset the business did fairly well, but a dissolution took place in March, 1922, and since that date the debtor had traded alone. The outgoing partner received £234 by instalments. During recent years the turnover had declined. In 1920 the sales were £7,421, but they had since fallen off. The debtor stated that the decreased sales were largely due to his credit being restricted, and owing to his inability to get goods he was unable to complete various orders. On behalf of the debtor an offer was made of a composition of 5s. in the £, payable in cash. After some discussion it was decided that a deed should be executed with Mr. W. A. J. Osborne, of Messrs. Corfield and Cripwell, as trustee. Mr. Osborne was instructed to re-assign the estate for a sum sufficient to pay a cash composition of 5s. in the £. The following are creditors:—

	£		£
Hall, John, & Co.	54	Richards, F. P.	142
Morrish & Co.	17	Stewart & Brown	27
Martorell	48	Shrimpton & Sons	88

The Associated Electric Co., 21, Waterloo Street, Glasgow.—In the report of the meeting of creditors of this firm in our issue of March 28th, we incorrectly stated that the firm's premises were held at a rental of £235 per annum. We are asked to state that the rental is £315, exclusive of rates, which amount to about £80 per annum.

Dissolutions of Partnership.—Dome Electric Co., electricians, 292, Stretford Road, Manchester.—Mr. R. Foden-Petchler and Mr. C. T. Rhodes have dissolved partnership. Mr. R. Foden-Petchler will attend to debts, and continue the business under the same style.

Tidswell & Poole, registered electrical contractors, Bazaar Street, Pendleton.—Mr. H. Tidswell and Mr. J. H. Poole have dissolved partnership. Mr. Tidswell will attend to debts.

Trade Announcements.—The Acme Electric Wire and Cable Co., Ltd., has recently been formed, with offices at Carlton House, Regent Street, London, S.W., and works at Shardlow, near Derby, to manufacture and deal in electric light wires, cables, flexibles, &c.

The Simplex Electric Co. (E. Ray Humphrey), 45, Harrow Lane, Brislington, Bristol, has been appointed sole agent for the United Kingdom for the "Marshall" constant-potential battery-charging system.

A company is now being formed—with headquarters at Manchester—to act as distributors to the trade in Lancashire and Cheshire for the wide range of batteries manufactured by Messrs. Pritchett & Gold and E.P.S. Co., Ltd., and Peto and Radford. Sub-agents are being appointed in all the leading centres.

Messrs. Lionel Robinson & Co., of 3, Staple Inn, London, W.C., have installed a second telephone line, "Holborn 6322," additional to "Holborn 6323."

The address of the new Scottish branch of Messrs. L. G. Hawkins & Co. is 97, Douglas Street, St. Vincent Street, Glasgow, not 57, as stated in our last issue. The new 'phone number is "Central 1604."

The London address of Messrs. Ruston & Hornsby, Ltd., is now Imperial House, 15, 17, & 19, Kingsway, W.C.2. For their Irish business the company has opened new offices and showrooms at 190, Pearse Street, Dublin, with Mr. T. C. Ives as resident manager.

Electrical Productions, Excelsior Works, Ellis Street, Birmingham, have appointed district representatives for the sale of their "Ventex" ironclad fuse gear as follows:—

London.—Mr. T. T. D. Geesen, 4, Clevedon Road, Penge.
Scotland.—David Alexander & Co., 43, Mains Street, Waterloo Street, Glasgow.
Lancashire.—Mr. H. H. Hopkins, 16, John Dalton Street, Manchester.
Yorkshire.—Mr. A. Wright, 11, Fernbank Road, Undercliffe, Bradford.

The telephone number of Messrs. Vickers-Petters, Ltd., London office, 75b, Queen Victoria Street, E.C.4, has been altered to "Central 6156."

The Vickers & International Combustion Engineering, Ltd., has removed from 4, Central Buildings, Westminster, to Africa House (5th floor), Kingsway, W.C.2, where in future all letters should be addressed. Telegrams: "Vickomb Westcent." Telephones: Holborn 1384-5.

Catalogues and Lists.—Autoveyors, Ltd., 84, Victoria Street, S.W.1.—A small poster illustrating "Clix" combination plugs and sockets and their applications to radio apparatus.

Messrs. Rose Bros., 25, Milton Street, E.C.2.—April price list of radio materials and accessories.

The Underfeed Stoker Co., Ltd., Aldwych House, Aldwych, W.C.2.—An illustrated description of the "Usco" air heater for boiler installations.

Messrs. Ward & Goldstone, Ltd., Frederick Road, Pendleton, Manchester.—April edition of "Radio List" containing illustrations and prices of receiving sets, accessories, and components. Also an illustrated and priced folder advertising "Sonola" receiving sets.

Electrical Components, Ltd., 88-90, Great Charles Street, Snow Hill, Birmingham.—Net price list (No. 108) of cables, conduits, and other electrical accessories.

Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester.—Five illustrated descriptive publications:—Nos. 1,290/1, choke coils; No. 1,300/1, oil drying and purifying equipment; No. 380/1-1, single-phase power transformers; No. 379/7-1, three-phase power transformers; and No. 364/2-1, potential transformers, dry and immersed types.

British Thomson-Houston Co., Ltd., Crown House, Aldwych, W.C.2.—A showcard illustrating "Radiola" crystal and valve receiving sets, loud speakers, valves, &c.

The Simplex Electric Co., 45, Harrow Road, Brislington, Bristol.—A pamphlet illustrating and describing the "Marshall" system of constant-potential battery charging.

London Electric Stores, Ltd., Oxendon Street, Haymarket, S.W.1.—A net trade price list of electrical and radio materials, including domestic appliances, switchgear, lighting fittings, &c.

Mr. Cecil Ridley, 35 and 37, Dundas Mews, Middlesbrough.—Trade price list of electrical and radio accessories.

Ivorine, Ltd., 349, Euston Road, N.W.1.—A card advertising the company's products, with a sample label in "Ivorine."

Henry Wells Oil Co., 11, Haymarket, S.W.1.—A booklet giving particulars and prices of "Germ Process" lubricating oils and a detailed explanation of their action.

Siemens & English Electric Lamp Co., Ltd., 38-39, Upper Thames Street, E.C.4.—April price list of electrical supplies of many kinds, including domestic appliances, lamps, lighting fittings, wiring materials, switchgear, &c.

Mr. O. N. Beck, 11, Queen Victoria Street, E.C.4. A pamphlet illustrating and describing the "Monarch" centrifugal oil purifier.

The Greengate & Irwell Rubber Co., Ltd., Greengate Works, Manchester. A very comprehensive catalogue of Association, non-Association, and C.T.S. cables. Fully priced.

Messrs. Pape & Bennison, 23, Stanley Road, Barrow-in-Furness. An illustrated leaflet describing "Paben" commutator mica undercutters.

Messrs. Cowlishaw-Walker & Co. (1920), Ltd., Etruria, Stoke-on-Trent. A descriptive catalogue (in French) of "Output" coal cutters.

Switchgear & Cowans, Ltd., Elsinore Road, Old Trafford, Manchester.—Catalogue Section 10-1 describing an unbreakable fuse carrier. Illustrated.

Ateliers de Constructions Electriques de Charleroi, 56, Victoria Street, S.W.1.—April stock list of motors and generators.

Messrs. John Harper & Co., Ltd., Albion Works, Willenhall, Staffs.—List No. A.24, containing illustrations of the various types of castings produced by the company.

Messrs. Wallace (Glasgow), Ltd., 6, White Street, Moorfields, E.C.2.—A series of pamphlets illustrating and describing in detail 3-h.p. and 6-8-h.p. single sleeve valve engines, and small lighting sets.

Messrs. Archibald J. Wright, Ltd., 395, City Road, E.C.1.—Two net trade price lists of radio receiving sets, components, and accessories.

Book Notices.—The Brush Electrical Engineering Co., Ltd., has published a new edition of its brochure upon "Brush-Ljungström" turbo-generators. Apart from its function as an advertising medium, the publication is of considerable value as a standard work upon the subject with which it deals. The reason for the design of each component is admirably explained, and the descriptions and illustrations convey a very clear conception of the machines.

"Transformer Standards" (3rd Edition). 40 pp. Cleveland, Ohio: The Electric Power Club.—This illustrated publication is a résumé of American practice in transformer design. It deals with such matters as standard ratings and their bases; performance specifications; manufacturing practice; lead markings, &c.

The English Electric Co. of Australia, Ltd., has published, in the form of a well-bound brochure, its tender for the construction of the Sydney Harbour Bridge. In addition to detailing very fully the company's proposals, the tender makes a number of interesting comparisons with several modern bridges, chiefly on the American continent.

"Alternating Current Armature Winding," by T. Croft. Pp. x+352; figs. 326. London: McGraw-Hill Publishing Co., Ltd. Price 15s. net.

"500 Wireless Questions Answered," by G. P. Kendall and E. Redpath. Pp. 133; figs. 39. London: Radio Press, Ltd. Price 2s. 6d.

"Foundry Work," by W. R. Needham. Pp. vi.+146; figs. 92. London: Blackie & Son, Ltd. Price 2s. 6d. net.

"Self-organisation for Business Men," by M. Dainow. Pp. x+144. London: Sir Isaac Pitman & Son, Ltd. Price 5s. net.

Catalogues for the West Indies.—Mr. H. Drummond, Government electrical engineer, St. George's, Grenada, British West Indies, is anxious to receive from British manufacturers their latest catalogues and price lists of small house lighting plants of 1, 2, and 3 kW, with kerosene or petrol engines, direct or belt-driven; also of fittings of all kinds, and wire.

Recent Contracts.—Messrs. Ed. Bennis & Co., Ltd., have sent us a long list of contracts recently awarded them for stokers and coal and ash handling plant. Among these are large orders from Swansea Corporation Electricity Department, Messrs. Cadbury Bros., Ltd., Kirkcaldy Corporation, Brighton Corporation, Messrs. Adam Hamilton & Sons, Ltd. (Paisley), the Great Western Railway (Swindon), and many other public and private concerns.

Orders for vacuum train-lighting lamps have been placed by the London, Midland & Scottish Railway Co. with the Metropolitan-Vickers Electrical Co., Ltd., and Siemens and English Electric Lamp Co., Ltd.

The Salford Corporation Tramway Department has placed an order for a large quantity of traction lamps with the Siemens & English Electric Lamp Co., Ltd., for the year ending March 31st, 1925.

Messrs. Vickers, Ltd., Barrow-in-Furness, have secured the order for a second unit for the Holborough Cement Works, Halling, Kent, comprising a large rotary kiln and cooler, and all subsidiary machinery, including electrical equipment manufactured by the Metropolitan-Vickers Electrical Co., Ltd. The company is at present erecting the first unit of the plant, and this work is nearing completion. The most up-to-date practice for the manufacture of cement is embodied in the works, and each unit will have a capacity of 50,000 tons a year.

Among the more important orders recently received by the Underfeed Stoker Co., Ltd., are the following:—Travelling grate stokers for Norwich Corporation (4), Carlisle Corporation (8), Brunner, Mond & Co. (6), and various stations in Japan (8); pulverised-fuel plant for the North Metropolitan Electric Power Co. and the St. Pancras Borough Council; ash conveyors for Brunner, Mond & Co., Carlisle Corporation, and Walsall Corporation; and an air heater for the Dunston power station.

Unemployment.—There was a further decrease in the number of registered unemployed during the week ended March 24th, the total being 1,063,500, as compared with 1,094,100 a week earlier. Since the beginning of the present year the total has decreased by 222,120.

The Easter Holidays.—Messrs. Higgs Bros., of Birmingham, announce that their works and offices will be closed from April 18th till 22nd inclusive for the Easter holidays.

Callender's Musical Society.—Callender's "Anchor" Cable Works Musical Society (Leigh) gave "Trial by Jury" and "H.M.S. Pinafore" in the local Hippodrome for a whole week recently, in aid of the Leigh Poor Children's Holiday Camp Fund. Enthusiastic audiences applauded the work of the artistes, and greatly appreciated the accompaniments by the Society's orchestra, which, we are given to understand, is one of the finest amateur organisations in the district. The performances were under the patronage of the Mayor and Mayoress of Leigh, and several of the company's London management and oversea representatives. A pleasing feature was the attendance of 800 school children, many of whom will compete for prizes offered for the best essays on their personal impressions of the "show."

Electric Light Fittings.—Messrs. David Shanks & Co., Ltd., of Birmingham, are exhibiting a large range of new designs of electric light fittings at the Griffin Hotel, Leeds, from April 7th to 11th, inclusive.

Workmen's Compensation.—The Director of Publications of H.M. Stationery Office announces the issue of a Memorandum on the Workmen's Compensation Act, to be obtained at the price of one penny and postage. The Workmen's Compensation Acts were dealt with in our issues of December 7th and 21st last, and there is, therefore, no necessity now to deal with the contents of the Memorandum. The Memorandum states the object of the Acts and gives an outline of the main changes in the law made by the Act of 1923. Particulars are given of the injuries and industrial diseases to which the Acts apply, with the persons entitled to compensation and liable to pay it, detailing the procedure necessary for claiming and recovering compensation and for reviewing and redeeming the weekly payments. Contracting out is dealt with, and the settlement of disputes by medical referees who have been given increased powers by the Act of 1923. The Memorandum is important in that it gives examples of the amount of compensation, particularly because the amounts now payable are more complicated than was previously the case. The appendices include the rates of compensation payable to disabled workmen whose average weekly earnings are less than 50 shillings per week. We recommend the purchase of the Memorandum by any one who is interested.

Bakers' Exhibition.—An attractive feature at the Bakers' and Grocers' Exhibition, opened in the Kelvin Hall, Glasgow, is the working demonstration of electric baking ovens by the Corporation of Glasgow Electricity Department. The Morton Machine Co., Wishaw, shows its patent dough brake, motor driven and fitted with the safety guard. Other exhibitors of machinery are:—Belhaven, Ltd., Wishaw; Thomas Melvin and Sons, Ltd., St. Rollox Iron Works, Glasgow; the Hobart Manufacturing Co., Ltd.; W. M. Still & Sons, Ltd.; Caterers' Appliances, Ltd., Glasgow; and the General Utility Co., Glasgow.

Proposed New Industrial Estate on the Thames.—We have received from the Thames Land Co., Ltd. (a subsidiary of S. Pearson & Co., Ltd.), particulars and maps of the new industrial estate (3,000 acres) on the River Thames, which it intends to develop with complete deep water, rail and road facilities. The scheme is for establishing this estate within 18 miles by road from London Bridge (mainly in the parish of West Thurrock). It is proposed to sell or lease the land in large or small sites for manufacturing or industrial works, and to give wharf and railway accommodation. The powers are to be sought under the West Thurrock Wharf and Railways Bill. The company to be incorporated will own and operate the wharf and all the railways of the undertaking.

Meeting of Creditors.—Gwynnes Engineering Co., Ltd. A meeting of creditors was called for April 9th to consider a scheme of arrangement. The scheme provides (according to the *Financial Times*) that the unsecured creditors other than Gwynnes are to remain creditors for the full amount of their respective claims, and Gwynnes, creditor for £371,195, to release the company from all claims in respect of £62,8 for interest and to accept 154,198 fully-paid shares in the company in satisfaction of £154,198 (approximately 10s. in the £ on £308,395). These shares are to be allotted to Gwynnes after the company's capital has been reduced and subdivided to allow that being done, such allotment to be made within six months of this scheme being sanctioned by the Court, and that company will rank with the other unsecured creditors for the remaining 10s. in the £—namely, £154,197. The secretary of Gwynnes Engineering Co., in requesting creditors to support the scheme, says that it is only intended to be the forerunner of the main scheme of reconstruction.

For Sale.—Bury Corporation Electricity Works has for disposal two Belliss & Morcom generating sets complete with condensing plant, pumps and pipework; Derby Corporation electricity department has for disposal one Parsons 500-kW turbo-generator, with surface condenser, pumps, &c.; Chester Corporation electricity works invites offers for surplus generating plant, &c. (See our advertisement pages to-day.)

National Trades Exhibition.—At this exhibition, which remains open until May 10th, the Birmingham Electric Supply Department has a well-equipped stand designed in the form of a dining room and kitchen. The former has a model lighting system, while in the "kitchen" demonstrations of appliances are given daily.

The Disposal Board.—The Disposal and Liquidation Commission, which, with its predecessor, the Ministry of Munitions, sold surplus war stocks for £665,000,000, came to an end on March 31st. The sale of surplus war assets and the liquidation of war accounts began early in 1919. There have been more than 3,000,000 separate transactions, including the work of liquidating the liabilities arising from the cancellation of more than 34,000 war contracts of an estimated value of £355,000,000 outstanding at the Armistice which necessitated the settlement of some 750,000 claims. The total material and stores handled amounted to approximately 5,000,000 tons. From April 1st the Commission's work will be taken over by a department of the Treasury to be known as the Surplus Stores, &c., Liquidation Department, of which Sir Daniel Neylan has been appointed head.—*Daily Mail.*

British Trade-Mark Applications.—The following are among the recent applications for British trade marks. Objections can be entered against any of the proposed marks within one month from the date mentioned:—

Aermonic. No. 443,861. Class 8. Apparatus for use in wireless telephony. James Christie & Sons, Ltd., 246, West Street, Sheffield, and Vincent R. Pleasance, 60, Fargate, Sheffield. April 2nd, 1924.

Superscale. No. 439,297. Class 8. Electrical measuring instruments. Everett, Edgcumbe & Co., Ltd., Hendon, N.W.9. April 2nd, 1924.

Chloride. No. 439,608. Class 8. Electric accumulators. The Chloride Electrical Storage Co., Ltd., Manchester. April 9th, 1924.

Becolate. No. 444,464. Class 40. Electric insulating material, composed chiefly of ebonite. The British Ebonite Co., Ltd., 25, Nightingale Road, Hanwell, London, W.7. April 2nd, 1924.

New Belgian Company.—A new company has lately been formed in Brussels with a capital of one million francs and the title La Société de la Pile Leclanché Belge, to manufacture Leclanché cells.

New French Company.—La Société de l'Energie Savoie et Dauphine is the name of a new company lately formed in Paris (73, Boulevard Haussmann), with a capital of 10 million fr., to establish power stations in the two departments named in the title.

New Showrooms.—Southport.—The Town Council has approved of the recommendation of the Electricity Committee for the use of the "Glaciarium" as electrical showrooms. The cost of converting the building for the purpose will not be more than £5,000, which will cover the cost of the provision of a new frontage, one or two showrooms, and a demonstration room.

Tramwaymen's Wages.—Following upon the settlement of the London tramway strike comes an announcement that the employés of the Manchester and Salford undertakings are considering an application for increased wages. The present rate, including bonus, is 62s. per week for drivers, conductors receiving 1s. per week less.

British Empire Exhibition Note.—On April 3rd the builders employed at the Exhibition, who ceased work on March 31st, were addressed by an official of their union, being told that the union could not recognise the strike. As a result the men decided to return to work, and activities were resumed the same day.

New Australian Company.—A new company has lately been formed in Adelaide (Industrial Buildings, King William Street), with a capital of £75,000, and the title of the Mid-North Electricity Co., Ltd., to establish a plant to supply the towns and districts of Clare, Blyth, Saddleworth, Gilbert, and Upper Wakefield with electricity for lighting and power purposes.

The Importance of Trade Marks.—MESSRS. RAYNER & Co., registered patent agents, 5, Chancery Lane, W.C.2, have issued an illustrated booklet dealing with the importance of registered trade marks, in which it is stated that unbranded articles are "no man's property—any man's opportunity."

Copper and Lead Prices.—Messrs. F. Smith & Co. report April 8th:—Copper (electrolytic) bars, £71, 5s. decrease; do. do. sheets, no change; do. do. wire rods, £81, 5s. decrease; do. do. h.c. wire, no change.

Messrs. James & Shakespeare report April 8th:—Copper bars (best selected), sheet and rod, no change; English pig lead, £35 5s., 10s. decrease on last week's quotation.

Lighting and Power Notes.

Aylesbury. — ELECTRICITY SUPPLY. — The Rural District Council has assented to Aylesbury Town Council's scheme for distributing electricity in the rural area. The Rural Council has requested that the cables be laid underground.

Birkenhead.—CORRECTION.—With reference to a note which appeared in our issue of February 29th (p. 338), we are informed that there is no joint sub-committee of the Tramways and Electricity Committees; there is a standing sub-committee of the latter to deal with matters of urgency. The matter referred to was a proposal to install additional plant.

Boston.—NEW POWER STATION.—At a recent meeting of the Town Council plans were passed for a power station to be erected by the Boston and District Electric Light Co., Ltd., and it was decided to use electricity for public lighting.

Bradford.—EXTENSIONS TO SUB-STATION.—The Electricity Committee proposes to extend the new Sunbridge Road sub-station at a cost of £1,785. The proposal has been approved by the Finance, Advisory, and Co-ordination Committee.

Carnarvon.—ELECTRICITY CHARGES.—The Town Council has decided to oppose the application of the National Electric Construction Co. for power to continue the maximum charge of 8d. per kWh, fixed under an emergency Order in 1919.

Continental.—BELGIUM.—The Société des Charbonnages de Ressaix, Leval, Peronnes, Saint Aldegonde, and Genck has decided to introduce electricity at its Saint Barbe pits. A central power station, comprising a 4,400-kW steam turbine and dynamo, is also being established at Peronnes.

FRANCE.—La Société Hydro-Electrique de la Tardoire has secured a concession for the supply of electricity for lighting and power purposes in the districts between Roumazières (Charente) and Piegut-Pluviers (Dordogne) and between Cheives-Chatelars and Marthon (Charente).

In order to meet the increasing demand for electricity, the Société Bruxelloise d'Electricité has recently installed additional plant at its generating station, the capacity having been increased from 16,500 to 23,000 kW.

The Société d'Electricité de l'Escaut, of Antwerp, has entered into an arrangement with the authorities of the Province of Antwerp for the supply of electricity to the communes in the eastern part of the province for a period of 20 years. The contract will necessitate the establishment of a 50,000-V overhead transmission line along the banks of the canal from the central station at Merxem as far as Beerse, and two transformer stations. The company has also secured concessions to supply electricity to the towns of Oostmalle, Ryckevorsel, and Beerse.

LUXEMBURG.—In a report upon the economic conditions in Luxemburg, reproduced in the *Board of Trade Journal*, the Commercial Secretary at Brussels says that the scheme brought forward in 1921 for centralising the production and improving the distribution of electric current throughout the Grand Duchy has made great progress during the past year, and is now on the point of being realised. The draft Bill empowering the Government to grant a concession was voted on the first reading by the Chamber of Deputies in November. The Council of State has approved the text of the Bill as voted, subject to certain slight modifications, and it is expected that the final vote of the Chamber on the Bill thus amended will take place in the immediate future.

BAVARIA.—According to the *Manchester Guardian Commercial*, the Walchen Lake power plant has recently been brought into operation. As the natural water supplies to Walchen were found insufficient, the upper course of the River Isar was partly diverted into the latter by means of a tunnel. A dam was further constructed on the Upper Isar near Krümm (the site of a contemplated water-power plant). When definitely completed, the power station will comprise eight turbines with a total capacity of 168,000 h.p. Three Francis turbines running at 500 r.p.m., and generating d.c. at 6,000 V, 50 cycles, have so far been installed. A set of impulse wheels running at 250 r.p.m. is shortly to be added, and will be used for the operation of the generators for railway supplies. The pressure will be raised to 100,000 V at a transformer station and the energy will be transmitted to Munich, whence it will be distributed to the surrounding districts. The Walchen Lake power station is mainly to be a "peak power house," supplying the surplus electrical energy in the evening hours and at other times, and allowing the existing steam-operated central stations to be worked at perfectly uniform load. Another water-power scheme, the Middle Isar power station, is rapidly nearing completion.

Cuckfield (Sussex).—ELECTRICITY SUPPLY.—The Rural District Council has been informed that the Electricity Commissioners have granted a Special Order to the Burgess Hill and District Electricity Co. for the supply of electricity in the district.

Elland.—ELECTRICITY SUPPLY.—The Electricity Committee has referred to a sub-committee for consideration and report an application from the Yorkshire Electric Power Co. for permission to supply electricity to houses at Ainley Top and Fixby in the Council's area.

Erith.—LOAN.—The Urban District Council is applying to the Electricity Commissioners for a loan for the provision of a duplicate e.h.p. cable between Erith and Woolwich.

Faversham.—NEW PLANT.—As a bulk supply of electricity for next winter cannot be supplied by Canterbury Corporation, the Electricity Commissioners have informed the Town Council that they are prepared to consider an application to install additional generating plant. Expert advice is to be obtained as to the most suitable plant to be installed.

Golborne.—SPECIAL ORDER.—The Lancashire Electric Power Co. has applied to the Electricity Commissioners for a Special Order authorising it to supply electricity in the Urban District of Golborne.

Guildford.—PLANT EXTENSIONS.—The Town Council has decided to purchase from the Reading Electricity Co., Ltd., a second-hand Belliss 712-b.h.p. triple-expansion three-crank vertical engine, coupled direct to a Siemens shunt-wound dynamo. The cost, including erection, overhauling, and accessories, is estimated at £3,850.

Guiseley (Yorkshire).—ELECTRICITY SUPPLY.—The clerk has informed the Urban District Council that the Electricity Order made by the Electricity Commissioners has been approved by Parliament, and the Electrical Distribution of Yorkshire, Ltd., is making arrangements to supply Guiseley almost immediately.

Hoylake and West Kirby.—SPECIAL ORDER.—The Urban District Council is applying to the Electricity Commissioners for a Special Order authorising it to extend its area of electricity supply so as to include the township of Grange.

Ilkley.—LOANS SANCTIONED.—The Urban District Council has received the sanction of the Electricity Commissioners to the borrowing of £3,050 for mains and £1,463 for plant. The Commissioners have also intimated their willingness to sanction a loan for the purchase of domestic appliances.

Irish Free State.—THE LIFFEY SURVEY.—The Dublin Corporation has adopted a report of the Electricity and Public Lighting Committee recommending the appointment of temporary assistants in connection with the River Liffey survey work.

ELECTRICITY SUPPLY BILLS.—Mr. M. Christie, examiner of private Bills to the Free State Parliament, heard objections by Sir J. Purser Griffith, Mr. J. W. Griffith, Mr. D. Figgis, and Mr. G. Marshall Harriss (general manager, Dublin Tramways) to the progress of the East Leinster Electricity Supply Bill. All the objections were overruled, and it was announced that Standing Orders had been complied with. A similar result followed on an examination in connection with the Dublin Electricity Supply Bill, objections by the East Leinster promoters being withdrawn. No objection was offered regarding the Sligo Lighting and Electric Power Bill, and proof of compliance was accepted.

In the Free State Senate the second reading was agreed to of the Electricity Undertakings (Continuation of Charges) Bill.

RIVER SHANNON SCHEME.—In a statement in the Irish Free State Parliament, President Cosgrave said, with regard to the River Shannon electricity scheme, that Messrs. Siemens, of Berlin, were being instructed to proceed on the basis set out in the recent White Paper, and that no liability for payment to that firm would arise until the scheme had been approved. The Government had decided not to promote the scheme itself; Messrs. Siemens had 12 months within which to do so. The only Government expenditure on investigation work would be in the employment of experts. The Ministry was not advised in the matter by any power supply engineer. The stage for such advice would come when Messrs. Siemens's detailed proposals were available. No other firm had sought the opportunity to put forward proposals. If Messrs. Siemens's scheme was sufficient for the whole of the Free State, it would not be necessary to develop others. The Institution of Civil Engineers and the Electricity Supply Association of Ireland had represented that the Government should employ consulting engineers to report on the Shannon, and that any scheme recommended should be put up to general tender, but rigid adherence to this procedure would rule out any such offer as that of Messrs. Siemens to satisfy experts that a national scheme on the Shannon was practicable, and would restrict the possibilities of electrical development.

Knaresborough.—Electricity in Bulk.—The Urban District Council has entered into a contract with the Harrogate Corporation for a bulk supply of electricity, and Mr. G. Wilkinson, Corporation electrical engineer, is preparing the specifications for the work. It is hoped to have the supply available by September next.

Leyton.—Loan Sanctioned.—The Urban District Council has received from the Electricity Commissioners sanction to a loan of £5,000 for additional plant for the generating station.

Liverpool.—Electricity Supply Accounts.—The accounts of the Corporation electricity undertaking (electrical engineer: Mr. H. Dickinson) for the 15 months ended March 31st, 1923, show a total revenue of £1,238,476. Working expenses amounted to £677,379, leaving a gross profit of £561,097, to which £2,775 has been added, being a contribution to sinking fund by the Housing Committee. This has been distributed as follows:—Interest, £172,717; repayment of loans, £1,255; contribution to Bootle stock redemption fund, £1,281; sinking fund, £132,112; renewal fund, £181,507; contribution to city rate, £75,000. During the 15 months the sum of £642,331 was spent on capital account, this included £242,527 for machinery, £155,345 for mains, £73,557 for the purchase of the Liverpool District Lighting Co.'s undertaking, £159,081 for the purchase of the Bootle Corporation electricity undertaking, and £11,820 for buildings.

London.—Bermondsey.—The Borough Council has received the sanction of the Electricity Commissioners to the borrowing of £4,683 for mains.

Luton.—Electricity Supply.—Dunstable Town Council and Leighton Buzzard Urban District Council have decided to support the application of Luton Corporation to extend its area of supply so as to include both towns. The estimated cost of the transmission line to Dunstable and the distributing system is £17,128, and the extension to Leighton Buzzard £18,682.

Maidenhead.—New Plant.—The Town Council has received the sanction of the Electricity Commissioners to the installation of a 200-kW oil-engine set at the electricity works.

Maidstone.—Loans Sanctioned.—The Town Council has received the sanction of the Electricity Commissioners to loans of £12,000 for mains and services, and £1,000 for domestic apparatus.

Manchester.—"All-Electric" Houses.—The Corporation is to erect 50 "all-electric" houses on the Burnage estate. They will be equipped with electric light, heaters, cookers, and washers.

New Zealand.—Hydro-Electric Development.—The erection of the Government hydro-electric generating station at Mangahao, in the Wellington district, is well advanced, and it is hoped that the plant will be ready for operation by June next. The electrical energy is to be transmitted a distance of 67 miles. As a safeguard against breakdown, duplicate transmission lines are being erected.

Price Reductions.—Reductions in the charges for electricity have been made or recommended in the following districts:—

Salford.—The surcharge of 40 per cent. on all lighting rates has been withdrawn and the following new scale introduced:—Flat rate, 4½d. per kWh. Maximum demand rate: 5 kW or under, a fixed charge of £9 per annum per kW plus 1½d. per kWh; above 5 kW, £7 10s. per kW, plus 1½d. per kWh. Lighting rates for power consumers: Varying from 4d. to 2d. per kWh, according to power consumption. Public lighting: A flat rate of 1½d. per kWh. The surcharge of 50 per cent. on heating and power rates has been withdrawn and the following scale adopted:—Heating: Flat rate, 1½d. per kWh. Power: Varying from 2½d. per kWh for the first 250 kWh per quarter to 1½d. per kWh for over 50,000 kWh, with special contract rates for d.c. supply.

Rathmines and Rathgar (Co. Dublin).—Power and kinematograph lanterns: 2½d. per kWh. Cooking and heating: 3d. per kWh.

Wimbledon.—Lighting: From 5½d. to 4½d. per kWh; through prepayment meters, from 7d. to 6d. per kWh. Basement and cellar lighting: From 4d. to 3½d. per kWh. Power: The tariff of 2d. to 1½d. per kWh, according to method of charging, is now 1⅝d. and 1.2d. per kWh. Cooking and heating: 1d. per kWh. Water heaters: Approximately ¾d. per kWh.

Doncaster.—Lighting: From 6½d. to 6d. per kWh. Theatres and kinemas: From 4½d. to 3½d. per kWh. Churches: From 5d. to 4½d. per kWh. Special rates for lighting: From 4½d. to 4d. Heating and cooking: From 2d. to 1d. per kWh from April to December, and 1½d. per kWh from October to March. Tramway supplies: From 1⅝d. to 1½d. per kWh.

Redcar.—Loan Sanctioned.—The Town Council has received from the Electricity Commissioners sanction to a loan of £9,500 for mains and plant in connection with the electricity scheme.

Skelmanthorpe.—Special Order.—Application is to be made to the Electricity Commissioners by the Urban District Council for a Special Order authorising it to purchase in bulk and distribute electrical energy in the district.

South-East Lancashire Electricity Advisory Board.—Engineering Advisory Committee.—At the first meeting of the South-East Lancashire Electricity Advisory Board for the year ending March 31st, 1925, Alderman W. T. Dagnall, of Manchester, was re-elected chairman and Alderman C. Hardman, of Oldham, was elected vice-chairman. The Board appointed an Engineering Advisory Committee, consisting of the following members nominated in accordance with the scheme:—Messrs. S. L. Pearce, C. D. Taite, W. J. H. Wood, F. L. Ogden, S. J. Watson, J. A. Robertson, R. Lomax, R. Owen, G. H. Fawcus, and H. C. Busbridge.

Torquay.—New Power Station.—The Corporation proposes to close down the existing power station at Beacon Quay and to start up the new station at Newton Abbot in June next.

Tynemouth.—Relief of the Rates.—The Corporation has decided to transfer £8,522 from the accumulated profits of the electricity undertaking to the relief of the rates.

Ulverston.—Inquiry.—The Electricity Commissioners will hold an inquiry on April 29th respecting the application of the Urban District Council to take a bulk supply of electricity from Barrow-in-Furness Corporation.

United States.—Electricity Schemes.—Progress is being made in connection with the new steam generating station which is being erected by the Illinois Power and Light Corporation at Tecumseh, Kan., to furnish Topeka, Atchison, and other districts in Kansas with electricity. A steel-tower transmission line six miles in length is now under construction between the new Tecumseh plant and Topeka, which will supply farms *en route*. Another line, 50 miles in length, will be erected from the new power station to Atchison. The ultimate capacity of the power station will be 60,000 kW; the first installation will be 15,000 kW, which, including the transmission line, will cost $2,750,000. Work on the first two sets has begun, and it is hoped to have the present development completed by the end of the year.—*Power.*

Tramway and Railway Notes.

Bradford.—Tramway Breakdown.—Failure of the electricity supply, due to a fault in an underground cable, dislocated the tramway service between the city and Thornbury and Bradford Moor on April 3rd for about two hours.

Burnley.—Tramway Fares.—The Ministry of Transport has made an Order extending the Burnley Tramways (Temporary Increase of Charges) Order to December 31st, 1924.

Continental.—France.—The steam tramway in the town of Ciota, in the Marseilles Prefecture, is to be electrified.

Belgium.—The Société Nationale des Chemins de Fer Vicinaux de Belgique is to electrify the Antwerp-Santvliet-Oostmalle-Lierre line. Operations will commence as soon as Government sanction has been received.

Spain.—The report of the Metropolitano Alfonso XIII for last year shows that the underground railway undertaking in Madrid is making steady progress. The company, which has a capital of 34 million pesetas, is now operating 7.7 km. of line, and during 1923 carried a total of 34,923,264 passengers, as compared with 30,131,202 in the preceding year. The number of car-miles run advanced from 2,704,202 to 3,257,583; the receipts reached a total of 5,879,412 pesetas, and the working expenses 2,621,828 pesetas. The electrical energy necessary for the operation of the system continues to be supplied by the Sociedad Union Electrica y Hidraulica, of Santillana, but the directors last summer established a reserve power station, comprising three sets of 1,500 h.p., in Madrid.

La Sociedad de Tranvias Electricos de Granada has secured a concession for the construction and working of a secondary electric railway between Alhendin and Durcat.

Italy.—The Consiglio Superiore dei Lavori Pubblici has adopted the recommendation of the Special Committee, and has appointed the Società Elettroviaria to carry out the works for the projected railway from Rome to the port of Ostia. This company has also in course of construction the Civita Vecchia to Orte line.

London.—Breakdown.—A breakdown occurred on the Hampstead and Highgate railway between Tufnell Park and Camden Town on April 4th. Traffic was held up for about two hours.

Newcastle-on-Tyne.—New Cars.—The Transport and Electricity Committee has decided to purchase 25 new double-deck tramcars from the Brush Electrical Engineering Co., of Loughborough, at an estimated cost of £60,000.

Opening of New Route.—The extension of the Newcastle-on-Tyne Corporation tramway system—the light railway which has been laid through Gosforth Park—was opened to traffic on April 4th. The extension consists of 1½ miles of double track, and connects the old Gosforth Park route with the West Moor route. The construction work has been carried out by Sir Robert McAlpine & Sons, Glasgow. In the park a central tramway station has been constructed with four lines of permanent way.

Railway Electrification.—The Minister of Transport (Mr. . Gosling) received a deputation of members of the Parliaentary Industrial Group at the House of Commons on April 1. Sir Arthur Shirley Benn headed the deputation, which cluded Sir Philip Dawson, Mr. P. J. Hannon, and Sir Fredk. ll. The deputation urged upon the Minister the need for e improvement of transport facilities and the promotion of hemes for the electrification of railways, particularly between rk and Newcastle, in Glasgow, and in the neighbourhood Liverpool and Manchester. The proposal was that the Comittee under the Trade Facilities Act should give more gener consideration to schemes of railway electrification than has en given hitherto. Mr. Gosling promised to take the proals into immediate consideration.

Telegraph and Telephone Notes.

France.—New Radio Service.—A radio-telegraph service as lately been inaugurated between France and Norway.

State Telephone Service.—As a result of the many comints it has received from commercial and industrial ncerns in the Paris district with regard to the poor telephone rvice, the Paris Chamber of Commerce has taken the subct in hand, and at a recent meeting, after a full discussion, opted a resolution that the French Government should, as a easure of urgency, submit a Bill to the two Chambers with e object of transferring the working of the telephone serce from the State to private undertakings. The reasons adnced for this course are: (1) That the French telephone rvice contrasts extremely badly with those of other countries, e inferiority being due as much to the defective character the material and the insufficient number of circuits as to e general poor organisation of the service; (2) that the State as failed to take the necessary steps to facilitate and extend e use of the telephone, and the fact that the telephone rvice results in an annual charge on the French Budget is oof that the State is not qualified to carry on the service a commercial basis. It is contended that if the service ere handed over to private undertakings not only would ey be able to make a profit, but more promptly meet the mand for improvements in the system and methods of rking.

New Cables.—Cable Ship's Departure.—The *T. Dellwood*, the United States Signal Service, after taking on board ble at Woolwich intended to be laid between Seattle and aska (the existing cables have been in use for a long period d require replacement), left for America on March 27th.

The Post Office.—1925 Estimates.—In the detailed estimates r the year ending March 31st, 1925, for the three Government venue departments (Parliamentary Paper 29—IX; price 2s. d), the Post Office estimate shows increases of £238,943 for laries, &c., £582,000 for the engineering establishment, 81,000 for engineering materials, £438,317 for the development of the telephone system, and £270,000 for radio broadsting. The estimate for broadcasting provides for a grant the B.B.C. of £300,000, as compared with £30,000 for the rrent year.—*The Times.*

The Telephone Service.—New Exchange.—A new telephone change to serve Finchley and Hendon and to be known as Speedwell" was opened at Golder's Green on April 5th. e equipment is of the central battery type and will, at e outset, provide for 3,280 subscribers' lines, with capacity r 7,820 lines. The district was formerly served by lines conted with Hampstead, Finchley, and Hendon exchanges; of ese, about 1,000 lines will be transferred to the new change. The name "Speedwell" has been chosen for the w exchange as being technically suitable, both now and hen automatic telephones are introduced at a later date.—*e Times.*

Radio Notes.

Bird Songs Broadcast.—Cardiff Experiment.—For the first me the songs of birds have been broadcast. Major Corbett nith, the Cardiff broadcasting station director, mounted the wer of Llandaff Cathedral on April 2nd, and placed a crophone in position. The chimes of the cathedral sounded e hour of five, and there followed a chorus of birds hovering out the towers.

Bogus B.B.C. Inspector.—Wimbledon Conviction.—At mbledon Police Court on March 31st Charles Henry amble (25), an engineer, and Hector Leonard Seagar (20) re charged on remand with stealing by a trick £1 from s. Elizabeth Bromley, of Wimbledon Park. Bramble was charged with stealing by a trick from Mrs. Kathleen St. n a wireless set and loud speaker worth £14 10s. Mrs. omley said the two men called on her and said she was ble to a fine of £50 because her licence had expired, and on amble promising to obtain one for her the same night she e him £1. Mrs. St. John said Bramble represented himself to be an inspector of the British Broadcasting Co., and said that as she had not a licence and her set was not stamped by the B.B.C. he had authority to cut down the apparatus. She believed him, and allowed him to take away the set. Mr. R. M. Page, assistant secretary of the British Broadcasting Co., said that neither of the men was employed by the company, which did not have inspectors to inspect licences or sets. Bramble, who had been previously convicted, was sentenced to three months' imprisonment, and Seagar was bound over under the First Offenders Act.—*Daily Mail.*

Edinburgh Relay Station.—Postponed Opening.—The opening of the Edinburgh relay station has been postponed until May 1st on account of the non-delivery of the generators, for which the makers have failed to obtain material from abroad.

Greece.—Radio Reception.—Some months ago the Revolutionary Government forbade by legal decree the operating of private radio apparatus in Greece. However, the Ministers of Finance and Marine of the present Government have prepared a Bill, to be submitted to the National Assembly for ratification, by which the operation of private radio sets belonging to Greek individuals will be permitted under certain restrictions and subject to the payment of a licence tax.—*Commerce Reports.*

Radio Insurance.—Some eighteen months ago a note in this column advised readers that it was possible for them to insure their apparatus against fire and other risks arising through the installation of a radio set; also that a cover was being granted to insure any third party damage up to the value of £500 (any one claim). The pioneer of this class of business (the Liverpool Marine and General Insurance Co., Ltd.) informs us that at least ten other insurance companies have followed its lead in this direction, which fact, in itself, proves that the subject has aroused considerable interest amongst owners of radio sets who prefer to insure rather than leave to chance whatever accident they may become liable for.

Sheffield Relay Station.—Proposed Power Increase.—Application has been made to the Post Office authorities for permission to increase the power of the Sheffield relay station from 100 to 200 watts.

Contracts Open and Closed.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared in our advertisement pages.)*

Open.

Aberdeen.—April 18th. Electricity Department. 90 tons (approx.) structural steelwork for the boiler-house extension. (April 4th.)

Argentina.—Buenos Aires.—May 28th. Department of Sanitary Works. Electrical power plant for the pumping stations at Pergamino.*

Barnes.—May 12th. Electricity Department. Two 500-kW rotary or motor converters, with h.p. and l.p. switchgear. (See this issue.)

Belgium.—April 24th. Municipal authorities of Peer (Province of Limbourg). Establishment of a l.p. electricity distribution system in the town. Particulars for 25 fr.

April 24th. Municipal authorities of Schaerbeek. 25 3-phase, four-wire, 110-V electricity meters.

April 29th. Municipal authorities of Bruges. Plant for the electric working of the Warande swing bridge. Particulars for 10 fr.

May 8th. Municipal authorities of Corswarem (Province of Limbourg). Establishment of a l.p. electricity distribution system in the commune.

May 13th. Municipal authorities of Ixelles, Brussels. L.p. armoured cable.

Cardiff.—April 24th. Electricity Department. One 5,000-kW turbo-alternator and condensing plant. (April 4th.)

Denmark.—Copenhagen.—April 25th. Municipal Council. Electrically-driven gas pump.*

Doncaster.—Electricity Committee. New pump in connection with feed-water supplies at electricity works.

Dublin.—April 30th. Electricity and Public Lighting Committee. Flame carbons. (April 4th.)

Edinburgh.—April 14th. Electricity Supply Department. Insulated cables, conduits, pavement box frames and covers, and house-service fuse boxes. (April 4th.)

Glasgow.—April 16th. Corporation. Electric lifts and electrical installation, &c., in connection with widening of Stockwell Street. Specifications, &c., from Town Clerk.

Parish Council and District Board of Control. Electric fittings for the hospitals. Mr. M. A. Reynard, inspector and clerk, 266, George Street.

April 26th. Electricity Department. Cables, meters, and carbons for 12 months. (See this issue.)

Haswell (near Sunderland).—April 15th. Parish Council. Complete system of public street lighting (about 82 lamps) by electricity for Haswell Ward of the parish. Plans and specifications from Mr. T. Gustard, Clerk to the Parish Council, Council Offices, Haswell.

Hornsey.—April 26th. Electricity Works. L.p. generator and feeder switchboards. (See this issue.)

London.—STEPNEY.—May 1st. Electricity Supply Committee. Coal-handling plant and ash-handling plant for the limehouse generating station. (April 4th.)

SOUTHWARK.—May 1st. Board of Guardians. Installing of a complete electric lighting scheme at the Southwark Hospital, East Dulwich Grove, S.E. (See this issue.)

MARYLEBONE. April 30th. Electricity Supply Committee. L.p. and e.h.p. cables for 12 months. (See this issue.)

LONDON COUNTY COUNCIL.—May 5th. H.t. switchgear, control panels, &c. (See this isuse.)

Manchester.—May 2nd. Electricity Committee. 6,600-V, 3-phase switchgear for sub-stations. (See this issue.)

New Zealand.—WELLINGTON.—July 1st. Public Works Department. Pipe lines for the Lake Coleridge electric power scheme.*

AUCKLAND.—June 23rd. Electric Power Board. One 5-ton electric travelling crane.*

WAIROA.—May 1st. Town Council. Centrifugal pumps and electric motors.*

Newport (Mon.).—May 1st. Electricity Department. 750-kW and 300-kW rotary converters, 500-kW house turbo-alternator, and ash-handling plant. (See this issue.)

Renfrewshire (Paisley).—April 21st. Education authority. Electrical work in connection with new administrative offices. Mr. J. Hamilton Pullar, Executive Officer, County Education Offices, Paisley.

South Africa.—JOHANNESBURG.—May 9th. Rand Water Board. Five coal elevators and 10 coal chutes at Zwartkopjes.*

Southampton. — April 30th. Electricity Department. E.h.p. 3-phase cables, e.h.p. switchgear, 3-phase transformers. (See this issue.)

St. Helens.—April 25th. Electricity Department. One 1,000-kW motor converter. (See this issue.)

Stoke-on-Trent.—April 16th. Electricity Department. 12 months' supply of a.c. and d.c. meters and maximum demand indicators. (March 28th.)

Warrington. — April 29th. Electricity Department. Steam pipes and water pipes. (See this issue.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Closed.

Aldershot.—Town Council. Accepted:—
50 controllers for electric street lamps under a five-years' agreement at the rate of 9s. 6d. per annum.—Horstmann Gear Co.

Bath.—Waterworks Committee. Accepted:—
Two pumps and two 90-h.p. motors, with automatic starter, switch, &c., for Charlcombe pumping station (£1,036).—Mather & Platt, Ltd.

Beckenham.—Urban District Council. Accepted:—
Two 2,200-V feeder cubicles.—Park Royal Engineering Works, Ltd.

Belgium.—Four tenders, including one from a French concern, were received on March 26th by the Belgian Post and Telegraph authorities in Brussels for the supply of 280 tons of bronze wire in six lots. The lowest offer for each of the lots was that of the Société des Usines à Cuivre et à Zinc, of Liége. For a small contract for the supply and laying of telephone cables, three home concerns competed, the lowest tender being that of the Société des Cableries et Corderies du Hainaut, of Dour.

Bexley.—The Urban Council, on April 2nd, received tenders for cable in connection with the bulk supply of electricity from Woolwich. A motion to accept that of Pirelli-General Cable Works, Ltd., a British firm, at £9,660, against an offer of £8,846 by Messrs. Watshams, for Dutch cables, was rejected, and it was decided to negotiate with the Pirelli-General Cable Works, Ltd., and Henley's Telegraph Works Co., Ltd., with the view of getting these firms' prices reduced to something comparable with Messrs. Watshams' quotation.

Bradford.—Electricity Committee. Accepted:—
One 480/550-V three-wire switchboard.—Bertram Thomas.
One 600-V armour-clad switchboard.—A. Reyrolle & Co., Ltd.
Works required in extension of Sunbridge Road sub-station.—Alfred Robinson.
Supply of transformer oil up to a total of 10,000 gallons during six months ending September 30th, 1924.—Ressoils, Ltd., Newcastle-on-Tyne.

Cannock.—Urban District Council. Accepted:—
Supplying and laying underground cable, Walsall Road to Heath Hayes (£3,290). Overhead distributor line (1,050 yd.) in Hednesford Road, Heath Hayes (£480).—British Insulated & Helsby Cables, Ltd.
Supply of additional cubicles at Queen Street, Chadsmoor (£540).—General Electric Co., Ltd.

Croydon.—Town Council. Accepted:—
Enlarging engine room, &c. (£4,714).—Truett & Steel, Ltd.
New workshop (£3,785).—R. Mansell.
Switchgear (£10,980).—English Electric Co., Ltd.

Board of Guardians. Accepted:—
Electrical goods.—Baxter & Caunter.

Doncaster.—Electricity Committee. Accepted:—
Cables (£1,049).—Enfield Cable Co., Ltd.

Dun Laoghaire (Kingstown).—The Urban Council decided, on the recommendation of the Electricity Committee to accept the following tenders:—
Switchgear and transformers (£3,207).—Drake & Gorham.
Overhead wiring.—Irish Electrical Construction Co.
Underground cables.—Messrs. Watshams, Ltd. (Belgian cables.)
The consideration of the tenders for engines and alternat was further referred back to the Committee.

Elland.—Elland Gas Co. Accepted:—
Electrically-propelled telpher plant for mechanical discharge of coal plies from canal barges.—Robt. Dempster & Sons, Ltd.

Glasgow.—Corporation. Recommended:—
Electrical work at Shettleston and Tollcross (£727).—D. Henderson.
Tramways Committee. Recommended:—
Telephone and test cable for Paisley.—Western Electric Co., Ltd.
Trolley wire.—Richard Johnson & Nephew, Ltd.
Rail anchors.—Bolckow, Vaughan & Co., Ltd.; and Thomas Green & Ltd.
Welds on Coatbridge renewal.—Thermit, Ltd.
Rails required for subway.—W. Beardmore & Co.

Kilkee (Co. Clare).—Lighting Committee. Accepted:—
Erection of power station (£799).—J. Partill & P. Marriman.

London.—METROPOLITAN WATER BOARD. Accepted:—
Gasfilled lamps for 12 months commencing April 12th, 1924.—General tric Co., Ltd.
BATTERSEA.—Electricity Department.
Two 6,600-V h.p. cubicles.—Park Royal Engineering Works, Ltd.

Oldham.—Markets and Baths Committee. Accepted:—
Electrical drive for machinery at Waterhead wash houses (£ Messrs. Ashton (Oldham), Ltd.

Salford.—Corporation Tramways. Accepted:—
Traction-type lamps for 12 months ending March 31st, 1925.—Metropo Vickers Electrical Co., Ltd.

Sheffield.—Electric Supply Committee. Accepted:—
Transformers of various types and sizes (£7,367).—British Electric T former Co., Ltd.

South Africa.—JOHANNESBURG.—Municipal Council. commended:—
Tramway motors and spares (£17,748).—Metropolitan-Vickers Elec Co., Ltd.
Reuter's Trade Service (Johannesbu

Windsor.—Board of Guardians. Accepted:—
Laying cables at the Institution (£300).—Windsor Electrical Instal Co., Ltd.

Forthcoming Events.

Institution of Electrical Engineers.—INFORMAL MEETING.—Monday, 14th. At the Institution. At 7 p.m. Discussion on "Some Idiosyncr of Electrical Manufacturers," to be opened by Mr. J. R. Bedford.

(Mersey and North Wales Centre).—Monday, April 14th. At University, Liverpool. At 7 p.m. Informal discussion on "Dom Electrical Appliances," to be opened by Mr. J. W. Beauchamp.

(North-Eastern Centre).—Monday, April 14th. At Armstrong Col Newcastle-on-Tyne. At 7.15 p.m. Annual general meeting.

(North Midland Students' Section).—Tuesday, April 15th. At Technical College, Bradford. At 7 p.m. Paper on "The Protection A.C. Transmission and Distribution Systems," by Mr. R. J. Huntley.

(Sheffield and District Sub-Centre).—Wednesday, April 16th. At Mappin Hall, Department of Applied Science, St. George's Square, S field. At 7.30 p.m. Paper by Prof. W. M. Thornton on "Some Resear on the Safe Use of Electricity in Coal Mines."

Institute of Transport (Students' Section).—Tuesday, April 15th. At Institution of Electrical Engineers, Victoria Embankment. At 5.30 Lecture on "The Rating of Railways and Docks," by Mr. A. J. Bricke

Institution of Civil Engineers.—Tuesday, April 15th. At the Institu Great George Street, S.W. At 6 p.m. Papers on "The Barton Po Station of the Manchester Corporation and the Transmission System Connection Therewith," by Mr. H. N. Allott and Mr. S. L. Pearce, on the "Dalmarnock Electricity Works," by Mr. W. Burnside.

Radio Society of Great Britain.—Wednesday, April 16th. At the Institu of Electrical Engineers, Victoria Embankment, W.C. At 6.30 p.m. cussion on "Power Transformer Design."

Edinburgh Electrical Society.—Friday, April 18th. At the Philosophica stitute, 4, Queen Street. At 8 p.m. Annual meeting and prize d bution.

Belfast Association of Engineers.—Saturday, April 19th. At the Muni College of Technology. At 7.30 p.m. Annual meeting.

Notes.

Power Station Visit.—On the invitation of Mr. W. F. Pinkney, the Newcastle-upon-Tyne Rotary Club visited C ville power station on Wednesday, April 2nd. Over 80 m bers attended, and in order to give as much informa as possible to the visitors they were split up into parties 12 persons, each group under a separate guide. The memb were subsequently entertained to tea by the Newcastle-up Tyne Electric Supply Co., Ltd. To mark the occasion company produced a souvenir booklet in which the hist of electrical development in the area was briefly review and which contained illustrations of the old Pandon D station and the very up-to-date Carville station.

High-Voltage Transmission in Germany.—The 220-kV transmission system "in Europe" is claimed to e in the supply area of the Rheinisch-Westfalischen Elektrici Ges., erected lately by the A.E.G.

Appointments Vacant.—Designs engineer (£300+bonus= £440) for H.M.S. *Vernon*. Electrical engineer (£500) for the Middleton Corporation Electricity Works. Engineer and manager (£350) for Dun Laoghaire Urban District Council Electricity Supply Department. Shift engineer for the Perth Corporation Electricity Works; assistant in the electrical engineering department of Halifax Municipal Technical College. (See our advertisement pages to-day.)

Local Societies.—ELECTRIC FURNACES.—A paper entitled "Electric Furnaces" was read by Mr. A. Glynne Lobley (reader in electrochemistry at Manchester University) before the Birmingham Metallurgical Society, on April 3rd, in which he described various furnaces designed for the melting of non-ferrous metals. He said most modern furnaces were quite reliable, if not fool-proof, but agreed that the capital cost was often unnecessarily high, even allowing for the small demand which at present existed. Emphasis was given to a plea for an extended use of the simple and reliable wire-wound furnaces. Examples were given (and shown on the screen) of what had been done on a large scale in America. Metallic resister furnaces, ranging from small laboratory types to industrial annealing furnaces, had not only been more satisfactory in every way than the fuel furnaces they supplanted, but had also been cheaper to erect and operate. The lecturer concluded with an account of a new non-metallic resister for temperatures up to 1,350 deg. C. (2,460 deg. F.). —*Birmingham Post*.

MOTORS.—Mr. W. E. Clarke, A.M.I.E.E., of the English Electric Co., delivered a lecture on March 29th to a crowded meeting of the Peterborough Engineering Society. Mr. Clarke was supervisor for his company during recent installations at the Peterborough power station, which has been almost entirely re-equipped. A film showing the construction of motors was much enjoyed, and showed machines ranging from 1 to 19,000 h.p.

PAISLEY ASSOCIATION CONCERT.—There was a large attendance of members and friends at the recent annual supper and smoking concert of the Paisley Association of Electrical Engineers. Mr. F. B. Humphriss, president, occupied the chair, and gave a brief résumé of the work of the session; the prizes awarded for papers were also presented, amongst the successful apprentices being Messrs. R. Goddard, J. Fairbrother, and J. Shannon, all of the local electricity undertaking.

The United States Electrical Industry.—At an E.D.A. salesmanship conference, held at Newcastle-on-Tyne on March 20th, Mr. W. F. T. Pinkney read a paper dealing with the above subject from personal observations. It was not uncommon in the new Western cities of the United States, he said, to find practically every possible consumer connected to the mains of the electricity supply authority, and yet these same cities were the very ones which were placing orders for large turbo-generators, &c., to meet the demands of newly-created loads. As in this country there were two views as to whom should sell appliances—contractors or supply authorities. The majority inclined towards the latter, saying that where the supply authority promoted a vigorous sales policy there were more contractors in a greater state of prosperity than where the authority did not sell apparatus. In general there was good co-operation between the two sections. The sales organisations included very good showrooms. From 70 to 80 per cent. of the appliances were sold on the extended-payment system, and they were far cheaper than in this country. The sales of washing machines on the extended-payment system were enormous, the large turnover permitting the sellers to work on a small margin of profit. Special selling "campaigns" were a feature of electrical merchandising, extra staff being engaged for the period. The lampholders being of the screw type, were much more largely used for appliances than was the case in this country; and push-button and pull switches were largely used. The manufacturers' works were extraordinarily well lighted and were kept remarkably clean. The high degree of organisation led to a very great output, the workers being specialists to a great extent. The welfare of employés was a special care in all works and shops, and the men were prosperous-looking and well paid.

In reply to numerous questions, Mr. Pinkney said that the extended-payment principle was adopted for wiring as well as apparatus. The cheapness of appliances was due to the extent of the demand and to standardisation. Enormous sums of money were spent in shop window lighting and decoration. The capital cost of supply was largely reduced by overhead distribution. In conclusion, he said that although British practice and American methods were not comparable, he thought that many of the underlying principles could be adapted to this country's needs.

The Electrical Trades Benevolent Institution.—ANNUAL GENERAL MEETING.—On Monday last the annual general meeting of the E.T.B.I. was held at the Institution of Electrical Engineers; Mr. J. Y. Fletcher occupied the chair, in the unavoidable absence of Dr. Alex. Russell, president. I.E.E. The report of the Committee and the accounts for the year 1923 were adopted. The income for the year was £2,682, as compared with £2,356 in the previous year, and the ordinary expenses were £244 (£241 in 1922). The number of grants increased from 34 to 44, and the amount paid from £332 to £474, both number and amount being greater than in any previous year. The amount carried forward to the balance sheet was £2,441, compared with £2,112 in 1922. The amount invested during the year was £2,932, bringing up the total amount invested to £21,732. Pointing out that the calls for help must become more numerous as the Institution grew older, the chairman said it was essential that the invested fund should be greatly increased. The Institution was kept in close touch with the Benevolent Fund of the I.E.E., to prevent any action being taken by the one that might be detrimental to the other, and to avoid overlapping in the granting of benefits. The working expenses were exceedingly low, a fact which reflected great credit on the hon. secretary, Mr. F. B. O. Hawes. With the exception of Mr. E. J. Clarke, who wished to retire, the members of the Committee who retired by rotation were re-elected, and Messrs. Price, Waterhouse & Co. were re-elected as honorary auditors. The question of appointing lady members of committee was discussed, and was referred to the Committee.

Educational. — SCIENCE MUSEUM LECTURES. — Engineer Captain Edgar C. Smith began a series of daily lecture tours at the Science Museum, South Kensington, on April 1st. The inaugural lectures, says *The Times*, will be followed by others devoted to the collections of scientific apparatus, only a portion of which, however, are at present on exhibition. As the new galleries are finished the exhibits will gradually undergo rearrangement, and it is hoped that the lectures will lead to a wider appreciation of the immense importance of our national collections.

Main-Line Electrification.—In our report of the discussion which followed the reading of Lt.-Col. O'Brien's paper at the Institution of Electrical Engineers on March 27th (ELECTRICAL REVIEW, April 4th, p. 556), some remarks were attributed to "Mr. Richards." We are informed that this contribution was made by Mr. A. E. Jackson after he had read the statement by Sir Philip Dawson.

The French Bauxite Industry.—M. A. Pablowsky points out in a French contemporary that the foreign trade in bauxite in 1923 was very satisfactory, foreign customers having returned to the mines which supplied them before the war. On the other hand, the French production is being threatened from all quarters. Attention was drawn a few months ago to the possible danger of competition from "alunite" for the production of aluminium as a consequence of recent discoveries. One fact is certain, namely, that the United States is developing its output of ore, which exceeded 350,000 tons in 1922, of which four-fifths came from Arkansas. Now South America in turn is turning out a quantity of the raw material. British Guiana, on the banks of the Demerara and less than 62 miles from Georgestown, and Dutch Guiana, not far from Paramaribo, contain considerable deposits which are all the more valuable as they can be transported by waterway. The value of the mineral is proved by the fact that the United States is already receiving some 20,000 tons from Guiana, and this circumstance will no doubt have the effect of closing the American market to French exporters, who have hitherto sent about 10,000 tons per annum to the United States. What, however, in the opinion of M. Pablowsky, is more serious is that England, which has so far been an excellent customer of the French, may be induced to substitute mineral from Guiana for the French product, seeing that the former would form a return freight for the ships taking out coal. It has also to be borne in mind that Greece is preoccupied with the question of utilising the bauxite formations which have been prospected since the war, while Germany, which has already taken a turn towards the Adriatic for supplies, will not fail to seize the opportunity for liberating itself from deliveries from France. All these circumstances, the author says, render more and more precarious the French trade in bauxite. No doubt it will be possible to conceive a more intense utilisation of the mineral in France, and, indeed, attention is already being paid to the question. Nevertheless, it is considered necessary to maintain the exports on a high level, the work of production employing a large population in Provence and Languedoc, and it is therefore suggested that the promotion of the export trade can only be effected by a reduction in railway rates and in ship freights and by an acceleration and improvement in the facilities for the shipment of the mineral at the ports concerned.

Converting Light into Sound.—The conversion of light into sound is a problem to which General Ferrié and the professors of the French Military Wireless Centre have devoted study. They have now produced an instrument, which has been described before the French Academy of Science by M. Jonast and Commandant Mesny, with the aid of which luminous signals can be greatly amplified and transformed into sound. By means of a high-potential 4-electrode valve the faint electric current produced by a selenium cell under the influence of light has been greatly magnified and, working in the Paris observatory, the inventors have obtained from the rays of the star Capella variations of current of 3.5 microamperes. By charging for ten seconds a small condenser, by means of the photo-electric cell, and immediately discharging the condenser, a tenfold amplification is obtained. By increasing the number of discharges to the valve from 10 to 15, and even more, per second, oscillations are established which produce sound, and in this manner optical signals can be conveyed by the telephone and the "chant des étoiles" becomes a reality. General Ferrié informed the Academy that experiments with this invention were being actively pursued in the laboratories of Les Invalides.—*The Times*.

Service Notes.—Course in Electrical Engineering.—The Admiralty is to institute a short course in electrical engineering to enable those engineer officers provisionally selected for later appointment to repair ships, to take charge of the electrical repair staff and repair work of those vessels, in addition to their present duties. This may be said to be the first step in the gradual transfer of duties in connection with the electrical installations of ships from the charge of the torpedo lieutenant to the engineer officer. The new course will consist of two months in the Vernon Torpedo School, for a descriptive study of ships' electrical equipment; and two months in dockyards and at the works of contractors, for a study of repair methods and appliances. Responsibility for the care and maintenance of the ship's electrical installation will continue to be that of the gunner (T).—*The Times.*

Electricity from the Menai Strait.—The *Manchester Guardian* states that Mr. H. J. Jack, managing director of the North Wales Power Co., Ltd., has submitted to the Ministry of Transport a scheme for the utilisation of the tidal flow through the Menai Strait for the generation of electrical energy. In the course of an interview with our contemporary, Mr. Jack said:—"The Menai Strait lends itself to the erection of a barrage at a very moderate cost. It is now proposed to spend a big sum on building a new bridge. This scheme might be combined with the barrage scheme, and the two objects might be accomplished at a minimum of cost. The barrage would include a lock for the passage of shipping, and would have a road on the top of it for heavy vehicular traffic. The Menai Strait scheme, in combination with the Aluminium Corporation and the North Wales Power Company's undertakings, would be complete in itself, and would, at comparatively low cost, prove the feasibility of the utilisation of tidal power, and if, as I anticipate, the amount of energy developed during the hours of tidal flow is greater than can be used in conjunction with the high-level storages, there would be the possibility of using this surplus by transmitting it by the Power Company's transmission lines to the Midlands and there connecting it with the transmission system from the Severn barrage."

The Neon Lamp.—At a recent meeting of the Physical Society of London several papers were read that dealt with the neon lamp. Messrs. V. A. Oschwald and A. G. Tarrant demonstrated a new photo-electric and ionisation effect, pointing out that for the discharge in such a lamp to start a certain minimum voltage is necessary which is affected very considerably by light or other ionising agents external to the lamp. This effect is believed not to have been previously recorded. The writers have investigated the light effect in some detail, and record that it is produced by illumination of any intensity above a very low value (0.01-ft. candle producing an appreciable effect), that it is caused by rays of a broad wave-band in the visible spectrum, with a maximum effect in the orange, and that the seat of the effect is located on the surface of both the metal electrodes, irrespective of polarity. A similar effect, but one whose mechanism is believed to be different, is caused by rays from uranium oxide and from an X-ray tube. In the latter case it was extremely well marked, so that it is possible to detect by this means X-rays from a very feeble tube at a distance of 90 ft. Certain practical applications of this effect were suggested.

A paper on "Certain Properties of the Osglim Neon-Filled Lamp," by J. H. Shaxby, B.Sc., and E. J. Evans, B.Sc., was read by Mr. Shaxby, and illustrated by a demonstration. The characteristic (voltage and current) curve of the "Osglim" lamp illustrates many of the properties of the discharge of electricity through rarefied gases. The identity of the sparking potential with that necessary to produce a minimal current through the gas, pointed out by Townsend, is clearly confirmed. Part of the characteristic is negative, and this results in the lamp discharge becoming intermittent on a direct current supply, over a certain range of external resistance, independently of any external condenser in the circuit. This tendency to a negative characteristic appears, whatever the current through the lamp, when any change is made in the circuit and produces instability at the moment of switching on the lamp, and in the case of a.c. supply causes an intermittent discharge during that part of the cycle when, so far as the supplied voltage is concerned, one would expect a continuous glow. Illustrations were given of the use of the lamp as an indicator in a commutator method of measuring the frequency of alternating currents.

"Notes on Some Electrical Properties of the Neon Lamp," by U. A. Oschwald, B.Sc., and A. G. Tarrant, B.Sc., were read by Mr. Tarrant. They consist of selected portions of a more comprehensive survey, and therefore deal with three isolated problems only, *viz.*:—(1) The wave form of an "oscillating" neon lamp; (2) the maximum frequency of an "oscillating" neon lamp; (3) the persistence of the ionisation in a neon lamp. (1) By means of a special accurately-timed switch, a neon lamp was thrown into the "oscillating" state, and its voltage measured after any predetermined interval (from 0.005 to 0.5 second). Thus the voltage-time curve of the "oscillating" lamp was plotted. Very close agreement with theory is found. (2) A neon lamp was made to oscillate at its highest possible frequency, which was measured by a tuned circuit. Measured frequencies did not agree well in this case with theory, but a maximum frequency of about 95,000 is observed. (3) A neon lamp was run at such a voltage that if the discharge were interrupted for any considerable time it would not restart, the voltage being below the minimum starting voltage for the lamp. The circuit was interrupted by a special high-speed interrupter for separate single intervals down to 5×10^{-5} seconds. In no case did the discharge restart, showing an ionisation persistence of less than this interval.

A paper on "The Critical Resistance for Flashing of the Low-Voltage Neon Discharge Tube," by J. Taylor, B.Sc., and W. Clarkson, B.Sc., was read by Mr. Taylor, and illustrated by a demonstration. It dealt with the resistance conditions necessary for the maintenance of the well-known phenomenon of "flashing" of the neon discharge tube. It is shown theoretically that there is a critical value R_c, for the resistance in series with the neon tube, below which no flashes can be obtained. This critical value of the resistance is expressed by the relation $R_c=E-r_B/k\ (r_B-r_A)$ where E is the charging voltage, r_B the lower critical voltage, r_A the cathode fall of potential (approximately), and k the conductance of the discharge tube. Experimental observations confirm this relation exactly in the case of the "Osglim" lamp.

The Organisation of Scientific Workers.—A meeting of technical engineers, chemists, and other scientific workers was held under the auspices of the National Council of Technical Staff Associations, in the Milton Hall, Manchester, on March 28th. In opening the proceedings, Mr. C. H. Wordingham, C.B.E., referred to the need of collective bargaining in industry. The workmen had already recognised it, and the professional and supervisory staffs were now slowly awakening to the same truth. The fact that engineers had been tardy in appreciating the importance of combination was not due to any lack of intelligence on their part, but was rather the natural consequence of the engineering profession being more varied than any other, and of its having so many avenues of approach. Employers had often taken advantage of this lack of organisation, and bitter experience had taught engineers that association and collective effort were essential if their material interests were to be protected. During the past ten years several societies had come into being with the object of looking after the economic welfare of engineers, but up to the present they had operated apart. The formation of the National Council was an attempt to bring them together so as to enable them to co-operate on matters of common interest, and on those grounds it was worthy of support.

Mr. R. Hazleton, secretary of the Society of Technical Engineers, then moved the following resolution:—"That this meeting approves of the efforts of the National Council of Technical Staff Associations to organise technical staffs in their appropriate associations for the furtherance of their economic and professional welfare, and urges all technical engineers, chemists, and other scientific workers to support these efforts." He said that the formation of the National Council marked a turning point in the history of the organisation of technical staffs, and if expectations were realised, from small beginnings it would eventually become completely representative of all those organisations which to-day existed for the furtherance of the welfare of technical and scientific workers. As the chairman had stated, the movement was really the outgrowth of the past ten years. At the end of the great war, the need for such organisations as the Electrical Power Engineers' Association, the Society of Technical Engineers, and the British Association of Chemists, &c., was widely recognised. Even the Institution of Civil Engineers in 1918 passed a resolution declaring that it would not object to its members joining a trade union, provided it was composed of men of similar standing. These various organisations, animated by similar aims and faced with similar problems, set out separately, each following its own path and remaining isolated from the others. It was believed that the new National Council would afford a valuable means of co-operation and would prove a useful instrument in attaining the ends which they had in view.

Mr. A. L. Lunn, in seconding the resolution, said that if the Council was to be a success every engineer and scientific worker must put something into it. The senior officials could do a great deal in this direction by stimulating enthusiasm. It might take years to achieve complete success, but it was well worth the sacrifice.

Mr. L. H. A. Carr, in supporting the resolution, emphasised the importance of technicians having a common end in view, *viz.*, the good of the industry as a whole, and working in co-operation to attain it. Both workmen and employers were organised, but the technical staffs were not to any appreciable extent, and they were in the best position to consider the problems of industry as a whole. It was to make this possible that the Council had been formed.

On being put to the meeting the resolution was unanimously carried.

Mr. J. F. Heslop then proposed:—"That this meeting recommends the National Council to approach the councils of the chief institutions, with a view to securing their co-operation and support." This was also carried unanimously.

Fire.—Considerable damage was caused by a fire which occurred on April 7th at the premises of Messrs. G. Hand and Co., electrical and gas fitting manufacturers, 69-71, Farringdon Road, E.C. The fire originated on the second floor, and continued until nothing was left but the outer walls. The hose had to be carried through the crypt of St. Peter's

Church, Saffron Hill, which was in serious danger of being destroyed. The official report of the London Fire Brigade states: "It is a building of five floors, about 60 by 45 ft., used as workrooms, showrooms, offices and stores, and about one-third of the basement, the three upper floors, and the contents were severely damaged by fire, and part of the roof was destroyed."

Summer Time.—Summer time this year will be a week longer than last year. The Summer Time Act, 1922, provides that summer time is to begin on the third Sunday in April, but if that falls on Easter Day, as it does this year, it will begin on the second Sunday, that is, April 13th. Sir Kingsley Wood is introducing a Bill on April 11th to make summer time last for a fixed period of six months in each year. It has been found impracticable to begin summer time simultaneously this year in Great Britain, France, Belgium, and Holland, though an agreement may be made for future years. Representatives of the four countries discussed the question at the Ministry of Public Works in Paris and the dates selected were: for France, Belgium, and Holland the night of March 29th, and for Great Britain the night of April 12th. It was suggested that in 1925 and 1926 the above named countries should agree on summer time from the first Saturday in April to the first Saturday in October.

Storage Battery Locomotive Competition.—Mr. E. Shinwell, M.P., Secretary for Mines, announces that the judges appointed in connection with the above competition, particulars of which were announced in September last, have determined that April 30th, 1924, shall be the date upon which the competition will be closed to entrants.

The Engineers' Club (London).—ANNUAL DINNER.—The first annual dinner of the club is to be held in the Connaught Rooms, on Tuesday, May 6th, at 7 p.m. The price of tickets will be two guineas each, inclusive. Members of His Majesty's Governments, past and present, and many distinguished scientists, engineers, metallurgists, chemists, and architects are being asked to the function.

Institution Notes.

Institution of Electrical Engineers.—INFORMAL MEETING.—At the meeting of the Informal Section, on March 31st, Mr. F. Pooley was in the chair, when Mr. F. Gill opened a discussion on "Economics in Engineering." He picked holes in the dictionary definitions of the term "engineer," and in the usual methods of teaching economics. He spoke of the dearth of literature dealing with engineering economics, and said he believed that engineering had given a new meaning to economics and that the engineer's job was to take up the education of the non-technical business man on financial matters as regarded plant, for the engineer alone stood between him and bankruptcy. He set out the lines upon which engineering projects should be formulated, and exhibited charts and tables on the lantern screen showing some astonishing comparisons of first cost, maintenance, and scrap-value of alternative cable systems. He also showed some notable differences in the inland revenue allowances for deprecintion of plant in Great Britain, U.S.A., and Germany, and suggested that engineers must combine to instruct the revenue authorities on those matters.

Mr. D. J. Bolton said that the crux of the matter was that fullest consideration should be given to the point of view of the user who was interested in the economics of the *service* and not that of the apparatus. The engineer, in stating his case should proffer better, cheaper, fuller, or longer service rather than dwell on the mere comparison of designs. Mr. B. O. Anson thought economics failed at critical times when comparisons were not possible.

Mr. H. Brown spoke of the difficulty of deciding what was maintenance and what was replacement. The sinking fund provision for depreciation was satisfactory if a change of tenure was not likely to arise. Messrs. C. S. Byng, W. Day, P. Dunsheath, O.B.E., P. Good, L. M. Jockel, S. W. Pook, W. E. Rogers, H. M. Sayers, and F. Tremain also spoke.

NORTH-EASTERN CENTRE.—The annual general meeting will be held on April 14th, at 7 p.m., at the Mining Institute, Newcastle-on-Tyne, when the Committee's report will be presented and the officers will be elected for the 1924-25 session. This will be followed by a lecture by Sir R. A. S. Paget, Bart., on "The Nature and Reproduction of Speech Sounds."

EAST MIDLANDS SUB-CENTRE.—Sixty members of the East Midlands Sub-Centre of the Institution visited Leicester on the 1st inst., representatives being present from Loughborough, Nottingham, and Derby, headed by Mr. E. G. Phillips, chairman (Nottingham) and Mr. J. F. Driver, secretary (Loughborough). The party was met by Mr. T. R. Smith, city electrical engineer, and conducted around the showrooms and offices in the town, afterwards making an inspection of the new generating station on Freeman's Meadow, Aylestone Road. Later the members met at the Town Hall, where they were entertained at tea by the Mayor (Councillor J. M. Hubbard) and Councillor A. H. Swain (vice-chairman of the Electricity Committee). Members later went into session, when a paper was read on "Steam evaporators and their application," by Mr. J. B. McLean (London) and Mr. E. G. Bossier (Derby). The lecture was illustrated with lantern slides; and in the discussion which followed Mr. Heasty (London) also used some slides. Other speakers were Mr. Mann (Lancashire), Mr. Nicols (Derby), Mr. Lake (Derby), and Mr. T. R. Smith, who remarked that the evaporating plant at Leicester was the first of its kind to be built.

Iron and Steel Institute.—ANNUAL MEETING.—The annual meeting of the Institute will be held on May 8th and 9th, at the Institution of Civil Engineers. In addition to domestic business, Sir W. Ellis will deliver his presidential address, Prof. Albert Sauveur will receive the Bessemer Medal, and the Andrew Carnegie research scholarships will be announced; 16 papers have been presented for discussion. The annual dinner is to be held on May 8th, and the autumn meeting will be held in London on September 4th and 5th, while the Empire Mining and Metallurgical Congress in connection with the British Empire Exhibition at Wembley will take place on June 3rd-6th, including a banquet at the Guildhall.

Institute of Patentees.—The report of the Executive Council for 1923 states that considerable progress has been made in increasing the strength of the Institute. A branch has been opened in Glasgow, and this has brought about an increase in the number of Scottish members. Among the matters which have been dealt with during the year are Imperial patents, free legal advice, and the placing of members' inventions before firms and individuals. A number of interesting lectures were given.

Women's Engineering Society.—INTERNATIONAL CONFERENCE.—The Society, founded more than four years ago, and having a membership of about 200, opened its second international conference at Manchester on April 3rd, when its president, the Hon. Lady Parsons, delivered the presidential address. A civic welcome was given at the College of Technology by the Lady Mayoress, Miss Jackson, who said she was glad to know that in the engineering trades those young women who had been taken on as apprentices were rated on terms of equality with boy apprentices in the matter of wages. Amongst the papers read was one by Mrs. McBerty, of the United States, on electric welding, with special reference to the products of the Federal Machine & Welder Co., which she represents. The annual report of the society stated that the London and Birmingham branches continued to make headway. The very friendly attitude of the large engineering institutions was a great encouragement. The Institution of Mechanical Engineers and the Institution of Railway Signal Engineers had each elected during 1923 their first woman member, and one of the members of the society had been admitted a college apprentice at a large firm of electrical engineers at Manchester. A number of the society's members had made valuable discoveries in scientific research.—*The Times.*

Our Personal Column.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

The Douglas Corporation has unanimously accepted the Electricity Committee's recommendation to increase the salary of the Borough Electrical Engineer, Mr. BERTRAM KELLY, A.M.I.E.E., by £53 per annum.

Mr. GEORGE D. SINCLAIR has been appointed electrical inspector of the Uganda Railway. He was formerly an electrical engineer in the employment of Messrs. Barry, Ostlere and Shepherd, Ltd., linoleum manufacturers, and left Kirkcaldy a year ago.

Barnstaple Town Council has advanced the salary of the electrical engineer, Mr. J. W. HADFIELD, to £425 a year, inclusive, and that of the assistant engineer, Mr. ALLEN, to £240 a year, inclusive.

Mr. NORMAN W. ANDERSON, engineer of the Shanghai Mutual Telephone Co., landed at Liverpool on March 29th from the Canadian Pacific liner *Montlaurier.*

Col. R. E. CROMPTON will attain the age of 80 years next month, and in order to celebrate the event in a fitting manner the Institution of Automobile Engineers, of which the colonel was the first president, has decided to hold a dinner at the Royal Automobile Club, Pall Mall, S.W., on Monday, June 2nd, at which he will be the guest of the evening, and will be made an honorary member of the Institution. Following the dinner Col. Crompton will give a lecture on "A Forgotten Chapter in the History of Road Transport."

Mr. B. C. WARD has been appointed distribution superintendent at the Croydon Corporation Electricity Works.

Mr. W. S. Ross, borough electrical engineer at Reigate, who has been on three months' leave of absence owing to a breakdown in his health, is well on the road to recovery, and hopes to resume duty about the middle of this month.

Mr. L. C. F. BELLAMY has resigned the general managership of the St. Helens tramways, and has accepted an appointment as general manager of the Hong Kong tramways. Mr. Bellamy took charge at St. Helens four years ago. The Council has decided to appoint a general manager to succeed him at a salary of £550 per annum, rising to £600 per annum by two annual increments of £25.

Mr. W. Lapper, one of the engineers on the Doncaster Corporation Electricity Works staff, and recently appointed to a similar position under the Wolverhampton Corporation, was presented with a barometer on April 4th by the staff and employés. In making the presentation, Mr. Windle, the chief engineer, said that it was always easier for a shift engineer to secure a better position if his particular station recorded a high thermal efficiency. Their engineers had taken a very keen interest in improving the efficiency of the station so that thousands of pounds were saved in the annual coal bill, and the Doncaster station was now among the highest in thermal efficiency in the kingdom.

Mr. George C. Usher, general manager and director of Vickers & International Combustion Engineering, Ltd., is sailing for the United States and Canada for a tour of inspection of the latest electric power stations. He expects to return in five weeks. Mr. David Wilson, O.B.E., who for the last 18 years has been on the staff of Messrs. Babcock & Wilcox, has joined Vickers & International Combustion Engineering, Ltd., as sales manager. He is now going to the United States and Canada for the purpose of making a close inspection of the working details of pulverised fuel plant.

Mr. F. W. Wheatley has resigned his post with the Southwark Electric Co., Ltd., and is taking up a position in the electrical department of Messrs. H. & C. Davis & Co., of Clapham Common, London.

Mr. S. L. Pearce, C.B.E., will sail on September 19th for Australia, to advise the Sydney Municipal Council with regard to its electricity undertaking.

Obituary.—Mr. H. V. Warren Hill.—The death took place, on March 31st, at his residence, in High Street, Broadstairs, of Mr. Howard Vernon Warren Hill, electrical engineer. Deceased, who was 53 years of age, was for some years in business as an electrical engineer in St. Peter's Road, and Pierremont Avenue, Broadstairs. He was a great-nephew of the famous Sir Rowland Hill.

Mr. H. Gover.—We regret to record the death, which occurred on April 2nd, at the age of 90 years, of Mr. Henry Charles Gover, who was for so long a period connected with the Edison & Swan United Electric Light Co., Ltd., as its secretary. Mr. Gover was well known in electrical circles. He was in harness until comparatively recent years.

Mr. George Hookham.—We regret to record the death, which has occurred at Broadway, Birmingham, of Mr. George Hookham, at the age of 81 years. For many years Mr. Hookham held a position of some prominence in the industrial life of Birmingham, having been a director of Kynoch, Ltd., and the old Telephone Co., in Birmingham. For some years he was in partnership with the late Mr. Arthur Chamberlain as electric lighting engineers, and the firm, in addition to carrying out an installation of public lighting in Leamington, obtained a concession for the electric lighting of the centre of Birmingham, disposed of later to the Birmingham Electric Light & Power Co., and by them to the Corporation. The funeral took place on Wednesday at Sheldon.

Wills.—The late Mr. W. J. Fisher, a director of the Aron Electricity Meter, Ltd., and other companies, left £5,904 gross and £3,734 net personalty.

Sir A. D. Reid, the celebrated authority on X-ray work, who died in Switzerland in January, left £28,227 gross and £28,082 net personalty.

The late Mr. C. S. Grenfell, a director of the City & South London Railway Co., left £60,000.

New Companies Registered.

J. B. Smith (Darwen), Ltd. (196,819).—Private company. Registered March 28th. Capital, £500 in £1 shares. To carry on the business of electrical engineers, electricians, and workers of and dealers in electricity, motive power and light, &c. The first directors are:—A. Duckworth (permanent chairman and managing director), 30, Cyprus Street, Darwen; J. B. Smith, 51, Cyprus Street, Darwen. Qualification, £10 shares. Secretary: J. B. Smith. Solicitors: C. D. Halliwell, 21, Railway Road, Darwen. Registered office: 51, Cyprus Street, Darwen.

F. W. Lowenadler (Sundries), Ltd. (196,758).—Private company. Registered March 27th. Capital, £2,000 in £1 shares. To carry on the business of manufacturers of and dealers in wireless sets and the component parts thereof, electrical and scientific apparatus, sundries and accessories, mechanical and electrical engineers, paper merchants, dealers in paper, pulp, dyed sateen, wines, spirits, liqueurs and matches, &c. The subscribers are:—F. W. Lowenadler, 40, Queen Victoria Street, E.C.4, merchant; O. Gillberg, 40-42, Queen Victoria Street, E.C.4, merchant. F. W. Lowenadler is permanent managing director with £50 per annum as remuneration. Solicitors: Kimber, Bull, Howland, Clappe & Co., 6, Old Jewry, E.C. Registered office: 40-42, Queen Victoria Street, E.C.

Bucks Electric Wire and Engineering Co., Ltd. (196,832).—Private company. Registered March 29th. Capital, £500 in £1 shares. To carry on the business of manufacturers of and dealers in drawn wire, electric cabling and electric lamps and all articles made from tungsten, molybdenum and other metal, &c. The first directors are:—A. H. Hyde, 137, Windsor Street, Wolverton, electrical engineer; C. F. Townsend, 111, Newport Road, New Bradwell, mechanical engineer; A. H. Applin, 53, Stratford Road, Wolverton, engineer; A. E. Eats, 5, Auckland Road, Ilford, electrical engineer; Mrs. D. E. Hyde, 137, Windsor Street, Wolverton. Secretary: A. H. Hyde. Solicitor: D. E. Bowen-Davies, 87, High Street, Newport Pagnell. Registered office: 4, North Street, New Bradwell, Bucks.

Williams-Stokes Wireless Co., Ltd. (196,740).—Private company. Registered March 26th. Capital, £3,200 in 3,088 ordinary shares of £1 each and 2,240 deferred shares of 1s. To acquire from Col. C. R. Stokes and W. Williams the business carried on by them as "Wireless Syndicate," and to carry on the business of importers, exporters, general merchants and dealers, manufacturers of and dealers in wireless or electrical fittings, &c. The permanent directors are:—Col. C. B. Stokes, Villa Meozowicki, Avenue Comba, Boulevard Gambetta, Nice, France; W. Williams, 77, Muncaster Road, S.W.11. Qualification, one share. Solicitors: Sturton and Sturton, 74, Great Tower Street, E.C. Registered office: 6, Broad Street Place, E.C.2.

Official Returns of Electrical Companies.

Montreal Tramways and Power Co., Ltd.—Particulars filed of £719,178 (or 3,500,000 dollars) 5-year 6 per cent. gold bonds authorised February 29th, 1924, covered by trust deed of even date, and created outside the U.K., charged on 21,000 fully-paid shares of 100 dollars each in the Montreal Tramways Co., and any additional shares of the same company that may be subscribed for by this company, the whole amount being now issued. Trustees: Royal Trust Co., Montreal. Particulars also filed of £1,643,835 (or 8,000,000 dollars) 5-year collateral trust gold bonds authorised February 29th, covered by trust deed dated March 1st, 1924, and created outside the U.K., charged on 7,000,000 dollars fully-paid 5 per cent. mortgage debenture stock of the Montreal Tramways Co., and 3,500,000 dollars 5-year 6 per cent. gold bonds in this company, the whole amount being now issued. Trustees: Royal Trust Co., Montreal.

E.S. Co., Ltd.—Debenture charged on the company's undertaking and property, present and future, including uncalled capital, dated March 21st, 1924, to secure £3,000 (ranking *pari passu* with £9,000 first debentures outstanding). Holder: A. J. Griffiths, Oaklands, Foxholes Road, Southbourne.

Cookham and District Electricity Corporation, Ltd.—Debenture charged on the company's undertaking and property, present and future, including uncalled capital, dated March 26th, 1924, to secure all moneys due or to become due from the company to Lloyd's Bank, Ltd.

British Arc Welding Co. (Mersey), Ltd.—First mortgage dated March 25th, 1924, to secure £3,000, charged on certain land and premises in Bootle, Lancs. Holders: Motor and Steam Wagon Repairers, Ltd., 44, Chapel Street, Liverpool.

James Keith and Blackman Co., Ltd.—Satisfaction in full on March 26th, 1924, of second debentures dated January 6th, 1913, May 15th, 1914, May 11th, 1915, and December 20th, 1915, securing £3,150.

Issue on March 25th, 1924, of £2,850 debentures, part of a series already registered.

Midland Counties Electric Supply Co., Ltd.—Satisfaction to the extent of £1,500 (balance outstanding) on January 26th, 1924, of charge by way of trust deed dated December 14th, 1921, securing £400,000 7½ per cent. debenture stock.

Johnson & Phillips, Ltd.—Satisfaction in full on July 1st, 1921, of second debentures authorised by resolution dated October 25th, 1911, securing £50,000. (Notice filed March 28th, 1924.)

Magnetic Transmission Co., Ltd.—Issue on March 28th, 1924, of £500 debentures, part of a series already registered.

City Notes.

Metropolitan-Vickers Electrical Co., Ltd.

The directors' report for the year ended December 31st, 1923, states that the balance available, including £105,310 brought forward, amounts (after providing for taxation) to £246,273, which has been appropriated as follows:—To general reserve account, £15,000; to dividends on preference and ordinary shares to December 31st, 1923, each at the rate of 8 per cent. per annum, less income tax, £145,755; to balance carried forward, £85,518. The report says:—"The year 1923 has been one of great difficulty in the electrical manufacturing industry. Owing to the depressed conditions prevailing in allied trades there was a considerable decline in the amount of business available. Competition both in the home and export markets was exceptionally severe, and the prices of orders taken have been on a lower level than in previous years. The company has secured certain important contracts during the year, and the result of some of these will only appear in subsequent accounts following completion of manufacture and delivery." The annual meeting was held at Westminster on Wednesday. (The report for 1922 (Elec. Rev. March 30th, 1923, p. 507) showed a profit including £92,815 brought forward, of £317,873. £35,000 of this was put to general reserve; 8 per cent. on the preference shares and 12½ per cent. on the ordinary, less tax, required £177,562; and £105,310 was carried forward, as shown above.)

British Electric Transformer Co., Ltd.

The report of the directors for the year ended December 31st, 1923, expresses regret that the year's trading has resulted in a loss (as forecast at the last general meeting). After paying all manufacturing costs, charges, and expenses of administration, this loss amounts to £22,130, plus depreciation reserve £4,000, making £26,130, less profit carried forward from last year, £8,137, and less amount transferred from reserve account, £17,992. The indications of the improvement of the company's business foreshadowed at the last general meeting have now become evident also. The loss for the six months ended June 30th, 1923, was £19,959, as published in the Press at the beginning of October last. The loss for the latter half of the year was £2,171. The aggregate value of the orders in hand as at December 31st, 1923, was more than double that at December 31st, 1922, and prices were at a more remunerative level. A letter was sent to all preference shareholders on August 31st last, pointing out that in view of trade depression, consideration of the question of the cumulative preference dividend was deferred. The directors now recommend that consideration of the question of payment of the preference dividend (which is cumulative) be deferred until the accounts for the present year are completed. Mr. T. Rowe resigned his seat on the board in September, 1923, as he found himself unable to devote sufficient time to the company's affairs in future. Mr. S. S. Lamert was elected to the board. **Annual meeting: April 15th, at Winchester House, E.C.**

omley (Kent) lectric Light and Power Co., Ltd.

The gross profit for 1923 was £29,132 (as against £24,637), and after the payment of debenture interest, trustees' fees, &c., making provision for depreciation and income tax, and adding £707 brought forward, a balance of £14,283 remains. The ctors recommend the payment of a final dividend of 6 cent. (making 10 per cent. for the year), the placing of 500 to general reserve, and the carrying-forward of £783. ring the year the connections increased from 6,073 to 6,490 ; a further portion of the company's area was changed to a.c. supply. Meeting, April 14th.

Canadian General Electric Co.

The *Financial Times* states that the profit for 1923 was $1,482,234, less $400,000 for depreciation of plant and $404,151 for interest charges, leaving $678,083, making available $7,498,494 (including the amount ught forward). Dividends at the rate of 6 per t. per annum on common stock and 7 per cent. annum on preference stock have been paid, and a divi- nd of 1¾ per cent., amounting to $35,000, was paid on ference stock for three months ended December 31st, 1923, en this stock was redeemed. The directors state that, ing in mind the possible expansion of the electrical in- stry in Canada and the necessity of extending the com- y's manufacturing facilities, it is probable that for some e it will be prudent to conserve cash resources and to surplus earnings after payment of dividends on preferred k to provide for such extensions rather than for payment dividends on common stock.

Chiswick Electricity Supply Corporation, Ltd.

The total revenue for 1923 was £57,554, as compared with £49,827 in 1922. The profit, after debiting a number of items to the revenue account, is £23,668, to which is added £2,622 brought forward, making £26,290. It is recommended that £12,500 placed to depreciation reserve, £1,570 refunded to con- mers, and a dividend of 12½ per cent. paid, absorbing £7,850, ving £4,370 to be carried forward. The expenditure on pital account was £7,073 at Chiswick and £1,434 at Aberyst- th. The meeting was held on Wednesday last.

French Companies.

The directors of the *Manufacture Parisienne d'Appareillage Electrique*, of Paris, report net profits and balance forward amounting to 453,000 fr. for 1923 and a idend at the rate of 125 fr. per share has been declared. he *Compagnie Francaise des Electrodes*, of Lyons, reports t the requirements of customers progressively increased a slight extent during the course of 1923 and that the same gularity in the receipt of orders continues in the present ar. Including the balance brought forward the net profits recorded at 1,492,000 fr. and a dividend at the rate of 8 cent. or 40 fr. per share has been declared.

German Companies.

The *South German Lloyd Dynamo Works Company*, of Erlangen, has brought forward to 1924 the net profits earned in 1923, which year saw a revival of business. e prospects are regarded as favourable. he *Bergmann Electricity Undertakings Co.* (a subsidiary the *Bergmann Electricity Works Co.*), reports net profit d balance forward amounting to 815,000 marks for 1922-23. ter defraying general expenses the balance has been carried ward. The *German Telephone Works and Cable Industry*, of Berlin, orts that its own works and those of its subsidiary mpanies were so abundantly supplied with orders 1923 that it was able to utilise the full pro- ctive capacity of the works. Nevertheless the net profits six billions of marks have been carried forward. The stag- tion in sales noticed at the beginning of 1924 has passed ay, and there is now an improvement which affords satis- tory employment for the works.

London Electric Wire Co. and Smiths, Ltd.—In their report for the year ended December 31st, 1923, the directors state at some additions have been made to plant and machinery meet immediate trade demands. The usual provision has en made in the accounts for depreciation. Throughout 1923 ere was a distinct improvement in trade over the previous ar, although a very large proportion of the business done as at cut prices. Full provision has been made in the ac- unts for all claims in respect of taxation to December, 1923. 0,000 has been added to the special reserve account to pro- ide against special contingencies. After paying the prefer- nce dividend, a final dividend on the ordinary shares of 6½ per nt., less income tax, is recommended, making the total per cent., less income tax, leaving £29,836 to carry forward.

Folkestone Electricity Supply Co., Ltd.—The annual eeting was held on March 29th, Alderman G. Spurgeon esiding. In the course of his remarks the chairman said at negotiations were in hand with the Dover Corporation th regard to the linking up of the two systems; such a heme would assist in increasing the efficiency of both sta- ns. The work of changing over the Hythe system to a.c. s well in progress, practically half of the consumers' instal- tions had been changed over. A small reduction was being ade in the charges to consumers.

S. Smith & Sons (Motor Accessories), Ltd.—At the annual meeting on April 2nd the chairman said that the net profit for 1923 (£7,035) had been applied to reduce the accumulated loss to £461,284. The bank overdraft had been decreased by £27,200 to £490,233, and since the close of the past year had been reduced further. The directors had come to the conclusion that it was necessary to reduce the capital by writing off £1,048,000. The investment in the M-L Magneto Syndicate would be reduced from £240,000 to £80,000, and investments in subsidiaries abroad from £100,000 to £23,000. After some discussion these proposals were adopted.

Birmingham District Power and Traction Co., Ltd.—The surplus, after deducting expenses, payments to local authorities, income tax, &c., was £75,488, and, adding £3,959 brought forward, a sum of £79,447 is available. After providing for debenture interest and sinking fund, preference dividend, and renewals, a dividend of 5 per cent. is to be paid on the ordinary shares, £4,031 transferred to reserve, and £11,023 carried forward.

Prospectus.—During last week the *Auckland Electric Power Board* published particulars of a £250,000 bearer debenture issue in £100 parts at the price of £97. The debentures are to be repayable at par in 1945 and a 2½ per cent. sinking fund is to be provided for this purpose. The issue is secured upon a special rate levied in Auckland and neighbouring districts, and is required solely for electrical development. Letters of allotment were posted on April 4th.

Bath Electric Tramways, Ltd.—A dividend of 2½ per cent. from the dividend reserve account is to be paid on the preferred ordinary shares. £8,000 is placed to contingencies and renewals account, and £2,184, representing revenue from dividends and interest, to dividend reserve account, which, after the payment of the above dividend, will amount to £294. £2,968 is to be carried forward.

Swansea Improvements and Tramways Co.—The revenue for 1923 was £149,519, an increase of £7,074, and the surplus, after deducting all expenses, was £16,926. To this is added £4,078 brought forward, making £21,004. A dividend of 6 per cent. on the ordinary shares is recommended, and it is proposed to place £3,000 to reserve, and to carry forward £7,605.

Algerian Company.—La Société Algerienne d'Eclairage et de Force reports a net profit of 2,005,067 fr. for last year, as compared with only 1,430,732 fr. in 1922. The dividend is, however, being restricted to 10 per cent., the same as for the previous year.

Hastings and District Electric Tramways Co., Ltd.—After the payment of an ordinary dividend of 2½ per cent., £7,000 is to be transferred to depreciation account and £5,000 to suspense account, leaving £660 to be carried forward.

Lima Light, Power, and Tramways Co.—This company (the Empresas Electricas Asociadas) has declared a dividend of 2 per cent., less tax, on the ordinary shares.

Brush Electrical Engineering Co., Ltd.—The directors recommend a dividend of 10 per cent., less tax, as in 1922.

Electrical Distribution of Yorkshire, Ltd.—The whole of the issue of 100,000 ordinary shares have been allotted.

English Electric Co., Ltd.—Dividend of 5 per cent. (less tax) on the ordinary shares for 1923.

County of Durham Electrical Power Co.—According to the *Financial Times* the profit for the year 1923 was £38,474, making available £39,791. Dividend 6 per cent.; £1,748 carried forward.

Hadfields, Ltd.—The directors recommend a dividend of 4 per cent., less tax, on the ordinary shares, for the year 1923, as compared with 5 per cent. for 1922.

Stocks and Shares.

MONDAY EVENING.

THROUGH its offer to holders of the 5 per cent. War Loan the option of converting, to the total extent of £200,000,000, their 5 per cent. War Loan into a new 4½ per cent. Conversion stock, the Government has done the Stock Exchange a very useful turn in attracting business and strengthening prices. The effect has been to tighten up quotations more particularly of investment stocks and shares. People who had been quite content to regard their War Loan as a permanent investment are realising that there may be something better to be done with it than keeping it for maturity, and, even where they have decided to let the stock

remain as it is, the mere advertisement which the Stock Exchange has received by reason of the discussion that has been raised, is all to the good of the markets.

It is natural enough, in the circumstances, that investors should be looking round to see whether there is anything more attractive than the 4½ per cent. Conversion stock which the Government offers, the return upon which works out to about £4 12s. 6d. per cent. on the money. The second debenture stocks issued under the Trade Facilities Act, 1921-22, by the City & South London, London Electric and the Central London Railways, all stand in the neighbourhood of 95½, at which the return on the money comes to about 4¾ per cent. Redemption takes place in 1942-72, and the interest dates are January 1st and July 1st. There is, or was when this was written, £10,000 City & South London 4½ per cent. debenture obtainable in the market at 95 free of stamp and fee, but investment is so keenly on the look-out for this class of stock that the little line may have been taken by the end of the week. These stocks are all, of course, guaranteed as to principal and interest by the British Government. It may also be useful to remind readers that the Tata Power 4½ per cent. guarantee debenture, redeemable by sinking fund at the beginning of 1928, by purchase under par or drawings at par, is also one of these Trade Facilities securities and the price is about 96. The difficulty is to obtain the offer of stock.

Home Railway issues are all better. The feature is the way in which the fixed-interest stocks have risen. Rises of 2 to 3 points are common throughout the lists. This has been reflected to a small extent in the ordinary and deferred descriptions. Metropolitans stand 1½ higher at 78, and Districts 1 up at 52½. Underground Incomes at 97 have recovered from the fall sustained last week. The settlement of the tramway and 'bus strike is still too near for people to forget its cost. Were it not for this, Underground Incomes would probably be standing nearer par, as, indeed, they deserve to do.

Electricity supply shares are very steady in their ex dividend shapes. Most of the prices are now ex. Allowing for this, the changes on the week are comparatively small. Edmundson's preference rose 3/16 and the ordinary shares ¼ to 5½ and 4½ respectively. Amongst the ex dividend markings are Bromptons, Chelsea, City and County, Newcastle preferences and South London ordinary shares. County ordinary have been a very active market, and after falling to 45/6, recovered to 47s. The provincial list is steady, Llanelly ordinary being 19s. 6d., Midland Counties ordinary 20s., and Clyde Valley 13½. The Cawnpore Electric Company is offering its shareholders 78,000 7 per cent. preference shares at par and the Egham & Staines Electric Lighting Company has a small issue of preference shares reserved for its proprietors, who will no doubt take advantage of this opportunity to acquire good stock at a reasonable price. There is fair supply of Yorkshire Electric ordinary available at 27s., of Calcuttas at 33s., and of Cawnpores at 23s. 9d. East African Power & Lighting new ordinary shares can be bought for 19s. 6d. or a trifle less.

Cable stocks are a good market. The investment character of the Eastern group has led money into the issues. The four ordinary are all up, Eastern gaining 3¼ points (allowing for the deducted dividend of 50s.) at 170½. Anglo-American deferred strengthened to 22½. Nothing has happened in wireless. Marconis went up a little to 34s. 3d., and dropped back again to 33s. 9d.

British Columbia new debenture came on offer at 6¼ premium, was promptly snapped up, and is now 7 premium. Several of the company's other stocks are better. Brazilian Tractions advanced to 59 on the further rally in the milreis. The Mexican Utility group holds its prices, though not too well; there seems to be, even at this eleventh hour, a doubt as to whether there will be the promised cash payment forthcoming on the Mexican Government bonds next week.

Holders of Brisbane Electric Trams are hoping that Mr. Theodore, the Queensland Premier who has just arranged a big new loan in London, will take steps to have the dividends paid on the shares, preference and ordinary alike. The shareholders in this company entertain strong feelings at the treatment they have received in connection with the taking-over of their property, and the whole matter has been referred to the Privy Council, which is not expected to consider the question until June next. The Queensland Premier, by one graceful gesture, could do much to remove the soreness that exists and to eradicate the unfortunate impression which embitters the minds of many genuine investors who hold these shares.

Brush Electrics are easier at 26s. 3d. General Electric preference gained a few pence; English Electrics went down a trifle. British Aluminiums have recovered the deducted dividend; Callenders at 2 7/16 are ex. Engineering, with iron, coal and steel shares, have gone a little better, in spite of labour-trouble threatenings. Babcocks hardened up to 46s. 3d. The rubber market remains uninteresting and slack. Last week's conferences, &c., at the Brussels Rubber Exhibition are declared to have been "very useful."

Share List of Electrical Companie

Home Electricity Companies.

	Nom. £	Dividend. 1923.	Dividend. 1923.	Price April 7. 1924.	Rise or fall.	Yie
Brompton Ordinary	1	12	10	37/-	—	*45
Charing Cross Ordinary	1	14	14½	44/6	-1/-	6 11
do. do. do. 4½ Pref.	1	4½	4½	17/-	—	5 6
Chelsea	1	10	12	1⅞xd	—	6 8
City of London	1	15	15	47/-xd	—	6 7
do. do. 6 % Pref. ...	1	6	6	23/6xd	—	5 2
County of London	1	10	15	47/-	—	6 7
do. do. 6 % Pref. ...	1	6	6	1⅛	—	5 6
Edmundson's Ordinary	3	7	7	4½	+ ¼	4 13
do. 6 % Pref.	5	6	6	5½	+ 3/16	5 17
Kensington Ordinary	—	12	14	10½	—	6 13
London Electric	3	10	10	4⅞	—	6 7
do. do. 6 % Pref. ...	5	6	6	5⅜	—	5 11
Metropolitan	1	8½	10	1⅛	—	5 13
do. 4½ % Pref.	1	4½	4½	17/-	—	5 6
Newcastle-on-Tyne Ordinary ...	1	2½	6	19/6xd	—	6 3
do. 5 % Pref. ...	1	5	5	16/9xd	-6d.	5 19
do. 7 % Pref. ...	1	7	7	23/6xd	+9d.	5 19
Notting Hill 6 % Pref.	10	6	6	9½	—	6 6
North Met. Elec. 6 % Pref. ...	1	6	6	22/-	—	5 9
Urban Ordinary	1	—	—	1	—	Nil
do 6 % Pref. ...	1	5	5	18/9	—	6 9
St. James' and Pall Mall ...	5	14½	17½	13½	—	6 13
South London	1	11	15	43/3xd	—	6 18
South Metropolitan Pref. ...	1	7	7	1⅛	—	5 13
Westminster Ordinary	5	12	15	10⅞	—	6 19
Whitehall Elec. Invst. 7½ % Pref.	1	7½	7½	20/6	—	7 6

Home Rails.

Central London Ord. Assented Stock	4	4	68½	—	5 16
Metropolitan ... ... ,,	3½	4	78	+ ½	5 2
do. District ... ... ,,	3	3½	52½	+1	6 13
Underground Electric Ordinary	10	Nil	Nil	2⅜	—	Nil
do. do. "A" ...	1	Nil	Nil	8/-	—	Nil
do. do. Income Bonds	5	6	97	+1	*6 3

Telegraphs and Telephones.

		Dividend. 1921	Dividend. 1923			
Anglo-Am. Tel. Pref.	Stock	6	6	102	—	5 17
do. Def.	,,	1½	34/6	23½	+ ½	6 13
Chile Telephone	5	6	6	6¼	—	4 16
Cuba Sub. Ord.	10	7	7	7¼	—	9 15
Eastern Extension...	10	10	10	17xd	+ ⅜	5 17
Eastern Tel. Ord.	Stock	10	10	170½xd	+3½	5 17
Globe Tel. and T. Ord.	10	10	10	17½	+ ¼	5 14
do. do. Pref.	10	6	6	10⅞	—	5 11
Great Northern Tel.	10	24	22	27⅞	—	8 0
Indo-European	25	10	7	22½	—	*5 7
Marconi	1	25	15	1¼	—	8 17
Oriental Telephone Ord.... ...	1	12	12	1⅞	—	*8 17
United R. Plate Tel.	5	8	8	6¾	—	*5 16
West India & Panama	10	Nil	Nil	1/-	—	Nil
Western Telegraph	10	10	10	16½	+ ½	5 19

Home and Foreign Trams, &c.

Anglo-Arg. Trams First Pref. ...	5	5½	12½	8⅞	—	8 9
do. do. 2nd Pref. ...	5	Nil	5½	2⅛	—	10 4
do. do. 5% Deb. ...	Stock	5	5	73½	—	6 16
British Electric Traction Ord. ...	,,	4½	5	74	—	6 15
do. do. 6% Pref. ...	,,	6	6	90½	—	6 0
Brazil Traction	100	Nil	4	59	+1½	6 15
Brit. Columbia Elec. Ry. Pcs.	Stock	5	5	83½	—	5 19
do. do. Preferred	,,	5	95/-	83½	+1	*5 15
do. do. Deferred	,,	8	127/-	101½	+1	*8 8
do. do. Deb.	,,	4½	4½	78½	+2	5 6
Lond. & Sub. Trac. 5 % Pref. ...	1	8½	5	6/-	—	8 6
London United Tram. Deb. ...	Stock	4	4	60	—	6 6
Mexico Trams. 5% Bonds ...	—	Nil	Nil	73½	—	6 16
do. 6% Bonds ...	—	Nil	Nil	80½	—	Nil
Mexican Light Common ...	100	Nil	Nil	23½	—	Nil
do. Pref.	100	Nil	Nil	41½	—	Nil
do. 1st Bonds ...	—	Nil	5	68½	—	7 6

Manufacturing Companies.

Babcock & Wilcox...	1	15	20	46/3	+6d.	*4 6
British Aluminium Ord.... ...	1	10	5	23/3xd	+9d.	4 5
British Insulated Ord.	1	15	15	2⅞xd	—	6 0
Callenders	1	15	15	48/9	—	6 0
do. 6½ Pref....	1	6½	6½	99/9	—	5 9
Crompton Ord.	1	10	5	⅜	—	9 17
Edison-Swan	4/-	10	Nil	4/9	—	6 6
do. ,, 5% Deb.	Stock	5	5	77½	—	6 9
Electric Construction	1	10	10	1⅝	—	6 7
English Electric	1	8	5	17/6	-6d.	5 14
do. do. Pref.	1	6	6	19/-xd	—	6 6
Gen. Elec. Pref.	1	6½	6½	98/6	+6d.	5 10
do. Ord.	1	10	5	21/-	—	4 15
Henley	1	15	15	2⅞	—	6 1
do. 4½ Pref.	5	4½	4½	4½	—	5 0
India-Rubber	1	10	10	⅜	—	*3 13
Met.-Vickers Pref....	2	8	8	9⅞	—	6 1
Siemens Ord.	1	10	10	16/3	—	Nil
Telegraph Con.	12	20	20	24	—	*5 0

* Dividends paid free of Income Tax

What is Electricity?

By H. E. YERBURY, M.I.E.E., M.Inst.C.E.

(*Abstract of paper read before the* SHEFFIELD SUB-CENTRE *of the* INSTITUTION OF ELECTRICAL ENGINEERS.)

HITHERTO time has done most of the winnowing of the true from the false, and the process will go on more rapidly when the intelligence of electrical engineers is manifested in a proper spirit, and they realise that the work yet to be accomplished is the enlargement of the boundaries of orthodox science.

What is orthodoxy to-day may be heterodoxy to-morrow, and many hypotheses of the past fail to sustain acceptance at the present moment. In this physical world all we can cognise is matter and movement. It appears that inherent laws which we do not understand determine far-reaching changes and we are already beyond the boundaries of direct sensory perceptions.

The author submits that the investigations in the realms of electrons and quanta, or energy levels, can still be brought into harmony with dynamical theories with an extended vision into the various forms of motion and all that that implies, and the intimate relations of the ether and matter through and by which forces are evolved.

Matter and energy are the realities to us. Space and time are the derived notions. If no objects, then no space; if no events, no time. *Now* embraces all time and *here* embraces all space. This world appears to be three dimensional, but it might prove to be a four dimensional complex. The possibility of a four dimensional development of space can be understood by our intellect, although no corresponding image of it can be conceived by the mind. It follows that the real existence of four dimensional space and the geometry of four dimensions can only be decided by experience or observation of facts. One common error is to confound cause and effect and entities or things with states.

Scientific induction must take the place of imaginative theories and it must suppress the all too prevalent materialistic concept of the monist, that a definition of a particular form of motion must be expressed in terms of matter as apprehended by our five senses.

Ether and its Manifestations.

The time has not arrived when that mysterious agent and cosmic ballast known as ether can be dealt with analytically or synthetically. The recognition that ethereal physics involves a totally different relativity from that in which we now live will have to be admitted. The classic distinction and separation of matter and energy, and matter and ether, which to some engineers should be differentiated, must, it is submitted, give place to the hypothesis, if not the proven fact, that ether and matter are not functioning in two separate worlds, but are unceasingly interchanging energies. Matter continuously emits radiations down to zero. It can also absorb them, so that we have a propagation of ethereal vibrations without which there would be neither light nor heat. To many physicists ether is more certain than matter although it has no dimensions or temperature, and is uniform, and cannot be compared by degrees in its own composition as it is infinite and may be conceived as the boundary of the material as we know it, for we have the material electron and the immaterial ether. We have in the etheric world a region where the hitherto hypothetical is deemed to be the actual. Ether permeates matter in every condition with an extreme sensitiveness, and there is a close and intimate connection and inter-dependence of physical and super-physical matter.

We, with our limitations, are forced to postulate two aspects of the universe. One is the physical, finite, or visible. This carries the appearance of reality to our finite senses, but it may be said to have no existence for us apart from those senses. The other is beyond our conception, because it transcends space, time and sense perception.

The author believes that the omnipresence of the ethereal ocean is to the physical and material universe the exciting and stimulating medium of all its activities and powers. There is an ethereal relativity connected with all manifestations of energy. One cannot interpret the relativity of things or effects in terms of the ethereal relativity of cause, which is the vital impulse that energises from the centre to the circumference through the universe of nature.

Ether includes potentially a distinctive nature of its own. This includes potentially the nature of matter as the greater includes the less. It is the medium between the various forces and matter. The author believes ether energy to be an endowment, and atomic energy an embodiment.

Molecules, Atoms and Electrons.

Sub-atomic energy is liberated spontaneously by radio-active bodies, and can also be liberated from all matter when it is raised by internal or external influences from its dense form to a more sublimated condition. The effluvium or auric emanations from all matter in a space and time atmosphere point to its universal dissociation. These emanations can be intensified by extraneous agents such as rays of light, and more especially by the ultra-violet rays. The product of this dissociation thrusts us into a new monism which declares that matter is a reservoir of energy and during its disintegration we may obtain unstable forms of energy such as light, heat, and electricity.

This transmutation process does not involve a dualism in Nature, but only the breaking up of a materialistic concept and the manifestation of two sets of faculties in ourselves, one set correlated to substances, things, and mechanical energy, &c., cognisable by our senses, and the other to an ethereal relativity which includes metaphysical possibilities and powers which cannot be brought within the purview of physical laws. It appears, therefore, that we cannot know the absolute, but are limited to the relative.

Ether may be deemed to be the irreducible element in the universe, because we cannot define it; all we can discern are its manifestations. Lines of force, although they appear to issue from matter, doubtless have their origin and are produced in the ether. They pass through electrical conductors and insulators and by a transmutation process various forms of energy are obtained. Matter may possibly be connected with ether by what we know as lines of force. The author submits that force and matter are indivisible. Force is the hidden and invisible but active partner of matter, while matter is the visible but apparently passive aspect of force and motion.

Equalities of velocity, whether in matter or ether, render manifestations of energy impossible, and there can be no exchange of energy unless they are out of equilibrium or at different tensions. Particles at rest cannot be called electricity, neither can the ether at rest be called light. Einstein's theory appears to prove that the wave motion in ether is subject to the influence of gravitation, while the ether itself is not subject to this influence. When in motion, ether might therefore be regarded as a frictionless, fluidic mass of ultimate atoms, and it is then affected by gravitational forces. The principle of motion appears to be the exciting stimulus of all we know as matter. The basic structure of the atom might be the resultant of spiral and centripetal motion of the ether, possibly in two or more phases combining dynamically.

Kinetic energy is attained by reason of the velocity of the rotating particles. Let it be assumed that matter is velocity. Any substance animated by velocity is also energy; therefore, matter from that view-point might be considered a particular form of energy.

It is significant that the invisible nucleus of an atom or proton as a separate entity has never been isolated. If its mass and stability is accounted for by its enormous constitutional rotation then there is an immense reservoir of forces in a dynamic state. Were we able to demobilise the proton The thought, therefore, suggests itself that the definite annihilation of such entity. The vortices of ether constituting the elements of atoms can transform themselves into vibrations of ether. It is not only the kind of movements, but also the variations in velocity which condition the nature of forces; and modes of energy are measured by these movements. It is suggested that the action of the wave motion of light is not in itself material, but simply a condition of the material, and therefore could not exist in the immaterial. There are particles of matter that suffuse every system and our visualisation of light is dependent on them. With ether, which permeates and surrounds all matter in its gaseous, liquid, and solid states, it may be assumed there is a perpetual thrill outwards from the nucleus and a rebound at the limit of density. This might be compared to the concentric rings from a stone thrown into a pond, which ripple out to the bank, from which other wavelets return to the source of disturbance.

The thought, therefore, suggests itself that the definite energy levels inside an atom where the electrons or negatively-*charged* particles circulate, are brought about by this perpetual welling up of forces and charges. In other words, the imponderable ether materialises and in its embodiment becomes endowed with structure, weight and inertia, manifesting fundamental physical existences. From a state, it thus becomes an entity, and as such gravitational and electrical levels are brought into operation.

The discontinuity of electrons and universal dissociation is the fundamental property of all matter, hence the theory that matter is indestructible will have to be abandoned.

If we admit that an electric charge possesses the distinguishing property known as inertia and it is believed that this can be shown by the phenomena of induction, &c., the theory is submitted that the definite energy levels inside an atom are brought about by the localised vortices of ether giving such strata a space relationship with a definite orbital speed of the electrons therein. It has been shown experi-

mentally that an electron can be propelled from one stratum or energy level to another, and that during its transit energy is radiated. We can thus visualise a transmutation process from a state to an entity and *vice versa*, which is a mechanical outcome of their own interactions. It may yet be proved or at least assumed, that inertia and gravity are different aspects of the same thing. In radiations we get a manifestation of energy, and this cannot be effected without an alteration in the state of either matter or ether. Agitations of matter propagate themselves in the ether, and the agitations and vibrations of ether suffuse matter. The atom has been aptly compared to a solar system, for every atom is in miniature a model of the universe.

What is Electricity?

The dogmatic assurance that matter is composed of electricity is thought by at least one engineer to be untenable.

It is suggested that there is a transformation process and that whenever matter is dissociated electricity is manifested. Electricity is, therefore, an intermediary substance between matter and the ether resulting from a disturbance of equilibrium. There is a flow of energy whenever there is a break of equilibrium. Matter is a stable form of energy, and electricity is an unstable form of energy. Electrons radiate whenever there is instability. This phenomenon precedes dissociation.

There can be no manifestation of energy in any form without a disturbance or a vibration in either matter or ether. It is submitted that matter is ether materialised and charged with electricity. By modifying the equilibria of matter ether is also disturbed, and light, heat, and electricity result. The elements which produce these effects have in themselves nothing calorific or electrical. Matter, especially in the etheric state, is highly sensitive to every kind of physical impact from without, and forces and influences from within. It is always the *effect* of the ever-present, all-permeating ether that we cognise by our senses, and not the ether itself, which is the potent medium for manifesting matter and all forms of energy—especially electricity—which has matter for its expression or body. Ether may be said to be a receiver, transmitter, and recorder of vibrations, and is acted upon by all forces. Light is not seen—we see its effects only. Much confusion of thought has arisen by assuming that a form of energy such as light is immaterial. It may be truly said from a philosophic point of view that the invisible is the real and the visible is only its shadow.

Phenomena Connected Therewith.

We cannot assume that by the cutting of lines of force in a magnetic field by a conductor it is the rotational movement of the coil which is transformed into electricity or that the power expended in such effort is transformed into electricity. It is more reasonable to suggest that the lines of force are abstracted from atomic energy—through the ether—and when cut or displaced by a conducting body an electric current is generated. Absorption, therefore, appears to be a transfer of the movement of the ether to the conductor placed in its path. Between electric waves and electricity there is a difference of the same order as that which exists between so-called radiant heat and heat by conduction. They are two different phenomena, since one occurs as a field of force in the ether, and the other with dense matter. Magnetic lines are always the accompaniment of electrical displacements, or in the static sense, field lines shifted laterally. It may be said that metals are opaque to electric waves and that dielectrics are transparent to these waves. The author submits that the wave or field of force does not consist of the radiation of electric and magnetic energy. The magnetic field, or component, is only cognised by the observer with a suitable detector or reagent in the path of the impulse. In other words, it is not self-existing, but is a function of the electric field, and only manifests itself when its velocity or kinetic energy is absorbed or detected by a receptive material or apparatus. It may reasonably be assumed that when the gyratory movement of material particles is transformed into other movements, such as a field of force in space, their particles no longer exercise any attractive action on each other, and consequently cease to be ponderable. All material phenomena, therefore, appear to have their birth in and through the ether, and during dissociation of matter different forces are generated, the most unstable of which is electricity.

Summary of Conclusions.

In considering electricity from an exoteric and also an esoteric view-point, imaginative concepts are often unconsciously imported into phenomena, and cause and effect are not infrequently confounded.

The author submits that the electronic theory has been carried too far, and the dogmatic assurance by many physicists that matter *is* electricity is thought to be untenable. Just as the property of the path of a planet affects the entity revolving therein, so it is submitted that the path of electrons in an atom of matter during its disaggregation are concomitant with the entities, energies, and agencies involved therein. The one cannot be dissociated from the other, neither should matter be considered apart from its surroundings.

Even a beam of light—visible or invisible—is capable of disturbing the equilibria of matter, and during this process electricity is manifested. The apparent stability of matter can easily be broken by either its own internal energies or external ones, such as an electrostatic or magnetic field impinging upon it.

Electricity is one of the most active agents in dissociating matter, just as electricity is one of the products of this dissociation. It can diffuse itself by conduction along a conductor or insulator, or by convection, by an emission of particles, and also by influence, and its velocity is determined by the conductivity or insulating property of the material used.

What is known as static electrification cannot be due to projections of particles or electrons from the influencing body, for an obstacle such as a sheet of glass does not arrest the action. Further, a negatively-charged body can give charges of varying sign according to the form of the electroscope. In like manner the so-called negative discharge can be positive according to the bodies employed.

Dr. Soddy claims to have shown that a disintegrating element which parts with Beta rays or particles charged with negative electricity, leaves behind it matter not associated with a positive charge. It is submitted that the classical dynamical theories cover the facts as at present understood, in a more complete manner than does the electronic theory.

The emanations from all forms of matter point to its steady dissociation, and because one cannot weigh the loss in a tangible body, in say a century of time, one should not infer that no change is taking place. If a rapid change or transformation is desired, then under the influence of very varied causes, such as heat, light, chemical reactions, &c., particles bearing charges of electricity can manifest themselves. Thus matter can be transformed or transmuted from one state to another and have an existence produced from, but not analogous to, matter.

There is a close relationship and inter-dependence between physical and super-physical matter. It is submitted that electrons are not the processes of matter, but the processes of the essence of matter, electricity being the ultimate physical reality. The ultimate essence of matter is so refined and sublimated that one can no longer conceive it as matter. In this metaphysical realm or state a new relativity is involved, for one is then associated with the irreducible elements of the universe.

Dr. G. le Bon was the first to evolve the theory that matter is a reservoir of intra-atomic energy, and during the dissociation of matter the energy stored therein on its formation is liberated.

Discussion at Sheffield.

Mr. D. G. Jones (electrical engineer, Messrs. John Brown and Co., Ltd., Sheffield) confessed that he had read the paper several times with the aid of a dictionary, and was still not quite as clear as he would like to be on some of the postulates advanced. It was extremely difficult when dealing with a subject of that character to obtain a mental conception which would allow one to visualise the author's meaning, especially in view of the ideas put forward. Mr. Yerbury believed that the omnipresence of the ethereal ocean was to the physical and material universe the exciting and stimulating medium of all its activities and powers. He (the author) suggested ethereal energy to be an endowment. Did he mean that this property of the ether had been bestowed upon it from without as an act of creation? Could it be that the two worlds, material and spiritual, were really one and the same world; that mental and physical were one and the same thing? Mr. Yerbury had referred to the principle of the conservation of energy, and hinted at the necessity of readjusting their views in accordance with recent discoveries. There was no doubt that extraordinary difficulties were presented to the well-trained engineering mind due to the entire subversion of ideas hitherto held on the subject.

"I drop a log of wood," continued the speaker, "into the sea from a height, let us say, of a hundred feet. A wave radiates from where it falls. Here is the corpuscular radiation producing a wave. The wave spreads, its energy is more and more widely distributed, the ripples get less and less in height. At a short distance, a few hundred yards perhaps, the effect will apparently have disappeared. If the water were perfectly free from viscosity, and there were no other causes to fritter away the energy of the waves, they would travel, say, 1,000 miles, by which time the height of the ripples would be extremely small. Then, at some one point on its circumference, the ripple would encounter a wooden ship. It may have encountered thousands of ships before that and nothing happened, but in this one particular case the unexpected happens. One of the ship's timbers suddenly flies up in the air to exactly 100 feet; that is to say, if it got clear away from the ship without having to crash through parts of the rigging or something else of the structure. The problem is, where did the energy come from that shot this plank into the air, and why was its velocity so exactly related to that of the plank which was dropped into the wafer 1,000 miles away? It is this problem that leaves us guessing."

Mr. E. Cross (general manager of the Rotherham Corporation Electricity Department) said that electricity as regarded by engineers behaved as a fluid which was weightless and immaterial—a description which was sufficient for them to base their calculations on. They could calculate what results could be obtained by its direct means as well as by induction or reaction. The dividing line between what might

be termed practical and theoretical work was moving upwards as they gained greater knowledge, and although the design of electrical machines was regarded in the usual vernacular as theoretical work, as those designs were carried out on known and fixed laws, such work must be regarded as practical in its strictest sense. To his mind theory was concerned with the traversing of fields of the unknown and uncertain, and as each theory was transmuted into established fact it was handed over to the practical engineer to make commercial use of.

There were various authors of scientific works who held the theory that matter was a reservoir of energy, and that during the dissociation of matter the energy stored therein on its formation was liberated. He held the view that advance in science to their needs would come by gradual evolution, just as in the past, and not in a succession of leaps forward. If they could make use of the low-grade differences of temperature and provide an engine which would take advantage of that energy which they knew was stored in such differences of temperatures they would have travelled a long way. They were aware that it took a certain amount of energy to raise a given amount of matter by a temperature of one degree and a multiple of that energy to raise the temperature of the mass by further degrees, but they could not regain the energy represented by such increased temperature. Although they knew the energy was there in the form of heat they could not devise a suitable engine fully to utilise it.

At it was usually found that "necessity is the mother of invention" scientific knowledge on those subjects might extend more rapidly as they approached the end of their resources in coal.

Prof. E. H. Crapper (Sheffield University) said they must all admit that Mr. Yerbury had presented them with a marvellous paper, and they ought to have time in order to form opinions on what he had put forward. The majority of the principles of the paper were not in conformity with those to which they had been accustomed. Engineering was nothing more or less than highly specialised applied science, and Mr. Yerbury had done valuable work if he had pressed that home. From that point of view it was an object lesson of what an engineer must do if he hoped for success. It would be a most interesting study to him (the speaker) to see if it were possible to associate the theory of magnetism with this new theory adduced by Mr. Yerbury.

Mr. W. E. Burnand said that, having heard the paper, he would like to ask Mr. Yerbury "What is electricity?" He was pleased to see that Mr. Yerbury was still a believer in their old friend, the ether. He himself saw no reason why there should be only one ether.

Mr. A. E. Jepson (General Electric Co., Ltd.) said that he read the paper about five times and was not then certain, but then there came to him in a flash Mr. Yerbury's psychical ideas, and he thought the paper might have some relation to them.

Mr. F. O. Hunt (Sheffield University) congratulated Mr. Yerbury on having the courage to tackle such a question. A lot of words were used by him which could be used in more senses than one, and until one had a knowledge that those words had a definite meaning it was difficult to discuss the matter with the knowledge that it would be understood what was meant by the use of those words. The author's statement that "I believe ether energy to be an endowment, and atomic energy an embodiment" he could not understand exactly.

Messrs. Wardale, Redmayne, Wadeson, Brockman, Lloyd, Lomas, and Thomas also took part in the discussion.

Mr. H. E. Yerbury, in reply, remarked that he thought that when atoms had radiated all their energy as vibrations they returned to the primitive ether from whence they came. The present-day problem was to change the wave-motion of ether into vortex motion, in which case an embodiment was manifested or a material entity evolved from a state. Life, he submitted, could be compared with ether. They did not know what it was. All they could discern was its manifestations.

Mr. Hunt wanted a better definition of words. The author agreed that many words and definitions required a different interpretation. For example, they still talked about "current consumption," whereas there was no "current" consumption at all, but "energy" consumption. Mr. Brockman had expressed surprise that an accumulator weighed no more in a charged condition than in a discharged one. The word "accumulator" was a misnomer, for no battery accumulated electricity. It produced electricity from chemical reactions, and there was a profound difference between molecular energy and atomic energy.

In answer to other questions he submitted that totally different results were brought about by an electrified body in repose and in motion. He thought electricity was never at rest. He could electrify a portion of a block of paraffin wax. It would take months for the charge to spread over the entire surface, for electricity was confined to discontinuous particles.

When he read that all matter was composed of electrons he thought the electronic theory had been carried too far. There were no electrons in the ether of space, for this medium carried the waves and radiations set up by the electrons. He submitted that energy and matter were essentially the same in origin, and matter had a basis of non-materiality. Concluding, he remarked that he had not put forward his paper as "crystallised dogma," but in the hope that the sum total of knowledge would be extended for the benefit of them all.

The Development of Power Plant.

Possible Future Progress.

The inaugural address which Mr. W. H. Patchell delivered on March 21st, as president of the Institution of Mechanical Engineers, was devoted largely to personal reminiscences of the development of prime movers for driving electricity generators; he discussed the possible lines of future progress, and in the course of his remarks commented upon the demand for electricity in the United States as compared with this country. The following is an abstract of the address:—

Regarding progress in prime movers, the thermo-electric efficiency and leading features of engines, turbines, and boilers from 1881 to 1921 when compared, indicate that high efficiency is not merely a question of size of unit. Concerning the thermal basis of comparison, it still seems to be the exception rather than the rule to record the particulars necessary for obtaining the figures correctly, but the real advantage of so doing is gradually becoming appreciated.

The highest thermal efficiency, however, may not always mean the lowest fuel consumption, although it generally does so. It is a matter of commercial as well as thermal economy. It sometimes pays to burn a larger quantity of low-grade fuel than a lesser quantity of high-grade fuel, and sometimes this position is reversed, as we cannot get any thermal units out of freight or costs of handling. This, however, does not upset the truth of the general proposition that the best method of stating steam power station economy is to give the B.th.u. in coal per kilowatt-hour sent out of the power station, as it is a very good criterion of both the design and the operation of the station.

British steam power stations with an output of over 30,000,000 kWh per annum are compared with corresponding American figures and with those of the Gennevilliers station, Paris.

At Detroit the three stations are all connected together, and the company attained its first day's output of one million kWh in the winter of 1913, the subsequent million increments being added in 1916, 1919, 1922, and 1923 respectively. The available plant capacity is 300,000 kW, the 30-minute maximum load is 319,700 kW. Reserve capacity none!

The speaker has had to consider with friends in the U.S.A. the arrangement and details of plant using boilers of 30,400 sq. ft. heating surface, 400 lb. working pressure; turbines of 50,000 kW capacity, with a single barrel; also steam-boilers with pressures of 1,200 lb. per sq. in. with suitable turbines. To give an idea of what these units mean, one of the big boilers such as are now being put down at the Trenton Channel plant of the Detroit Edison Co. will generate steam to develop about 25,000 kW. Such units are not only possible, but practicable, in the U.S.A., not because the American engineering is better, either in design, workmanship, or material than our own; it is the direct outcome, not of their engineering, but of the skill and zeal of those who handle the sales department of the electricity supply undertakings. No doubt they find customers more ready to listen to their charming, but where do we in England hear the voice of such charmers?

The comparison of the kilowatt-hours sold by several British and American undertakings indicates that the American consumption of electricity per head of population per annum would never have been from 500 to 700 kWh if it had been left to the consumer to go out and buy it. It is because people have, after study, gone out to sell it, and they have sold it. Now the public are not only happy in paying for it, but are eagerly wanting more. What is needed is a broad view of the commercial side of the business, and its possibilities.

We have a population of some forty millions and one 30,000-kW machine. The population of the United States is about 100 millions. I jotted down in an American train last year as many 30,000-kW sets as I knew were on order, and handed it to a travelling companion to supplement it. We had nothing but our memories to work on, no notes or papers, but the list amounted to 915,000 kW for home supply only. Inquiry showed that one maker had uncompleted orders for

1,845,000 kW in units of 20,000 kW and over. The figures set one thinking of what mechanical engineers might be doing if the electricity supply authorities stimulated a demand.

Apart from the electrification of industry, which on its intrinsic merits has been said to be a service to society and to humanity, is the more domestic electrification of the home. The electrification of our main-line railways appears to be shelved again, but it does seem certain that if one management would only make a start and "go in with both feet," the satisfaction which is being obtained abroad would be reproduced in this country.

Money spent on engineering equipment in this way would at any rate have an excellent chance of earning a return at an early date, whereas money spent in maintaining the unemployed workers and their families, who might be engaged on such schemes, is undoubtedly lost. When the electricity authorities really get busy and sell electricity it will bring a flood of work into the shops of mechanical and electrical engineers. I would beg the manufacturers not to be caught napping, but to be ready to deliver machines at reasonable dates after receipt of orders. I believe there would be little prospect of this with our existing facilities for manufacturing power plant; we often take an inordinately long time to build power plant, which again is disappointing to users of power. Would it not pay better if we speeded up all round instead of each trading on the slowness of the other suppliers of material without which our own particular item cannot be put to beneficial use? It is an economic question, but interest on locked-up capital is often overlooked, and it is a heavy item when construction is unduly prolonged.

Regarding the direction in which progress points at present, and some of the limitations, is it realised how rapidly the cost of service from hydro-electric plant rises as the locality of the demand recedes from the power plant? Electricity from water-power is too often deemed synonymous with low-priced electricity.

The generation of steam at the so-called critical temperature, 3,200 deg. F., when its density equals that of water, is being tried out on a small scale by the English Electric Co. at Rugby, but the pressure would appear to militate against its consideration for large power plant in the present state of the art. The boiler is reported to have been successfully tested at full pressure and 725 deg. F. temperature. Prof. Ellenwood, of Cornell University, and Mr. C. F. Hirshfeld read a paper at the American Society of Mechanical Engineers' annual meeting in December last, in which they calculated the theoretical efficiency of various heat cycles. The authors find that 600 lb. is the best pressure when coal is from $5 to $8 a ton, and that it is not worth while to go to 1,200 lb. per sq. in. They also find that with $5 coal and 600 lb. pressure it is immaterial what cycle is used other than the Rankine. From the thermal point of view the reheating regenerative cycle is the best from about 600 lb. working pressure upwards, but the plain regenerative so nearly approaches it that it is doubtful whether the extra complication of the reheating-regenerative system is worth while, as the difference may easily be accounted for in actual working.

With the best of apparatus, design, and material now available we cannot, on paper, see more than one kWh produced out of 1 lb. of best Welsh coal. We must, too, always remember that our nearness of approach to this figure depends even more on the load factor and the handling of the plant, particularly in the boiler-room, than it does on the design.

When once pipes are connected up joints ought to be capable of being forgotten. Why not weld them and put them one stage nearer that goal?

Structural considerations will, I fear, limit the size of high-pressure units until more experience has been obtained, and will no doubt lead to designs of boilers very unlike those now obtaining, while high steam pressure will tend to decrease the size of the turbine castings and so mitigate some of the dangers. The mercury vapour turbine has more claims for the betterment of existing plant than as a unit in a new large station. In other words, old boilers may be replaced by mercury turbine units which will, without scrapping the old turbine plant, raise the station overall efficiency. The Hartford machine is running regularly, giving 1,500 kW from the mercury turbine, and steam delivered into the station mains which produces another 2,000 kW in the old turbines. The price of mercury is now 50 per cent. more than it was before the war. The cause for anxiety is the possible inadequacy of the supply.

Makers are willing to offer turbines and boilers for 1,200 lb. pressure and, say, 750 deg. F. steam temperature, but much more knowledge of what may happen is wanted to ensure a feeling of security to those who have to operate such a plant. The material of which the boilers are in future to be constructed is by no means settled.

When considering the drum plates for the Trenton Channel boilers, with 30,400 sq. ft. water heating surface and 28 ft. by 48-in. drums, to work at 400 lb. pressure, nickel-steel and mild steel were both under review, the latter being preferred. The plates used are 2 in. thick. The boilers in this case are of the Stirling type. Similar plates are being used in boilers of the Babcock-Wilcox type with 15,000 sq. ft. heating surface to work at 600 lb. pressure. The drums for the 1,200 lb. Babcock-Wilcox boilers with 19,743 sq. ft. heating surface now in hand for the Boston Edison Co. and elsewhere, are forged steel cylinders, 48 in. inside diameter, 56 in. outside diameter, and 34 ft. long. The manufacture of such drum forgings can only be undertaken by a few selected masters of their trade. The alternative to the use of such huge masses of material to meet the new pressures and temperatures is either a radical alteration in the design of our steam generators or the use of alloy steels.

When we consider the high degrees of technical skill and supervision entailed in the manufacture of parts constructed of such alloys, we must agree that we are not yet prepared to pay the price which must be asked for boilers made under such conditions, nor can we expect them to be turned out of an ordinary boiler shop. It would appear that the most important thing is to keep the temperature below some specified amount which it would appear for ordinary steels at the present time should be, in order to ensure a factor of safety of at least 2, not more than 425 deg. C.

The domestic fire is still the main culprit in polluting the atmosphere, but smoke abatement can only be brought about by the production of an alternative, equivalent in comfort and no dearer.

In larger establishments we handle all the different classes of coal, but the varieties which any one station will handle economically is limited, and so we often find ourselves restricted to coal of one particular class. It is just here where pulverised fuel helps us. Hence this system is being adopted in preference to burning lump coal where a continuity of supply of a given coal cannot be relied upon.

The efficiency of the best mechanical stokers, when properly set and handled, is very high; indeed, there is very little between their performance and powdered fuel burning. It must be borne in mind, however, that although stoker efficiency may be slightly improved, there does not appear to be much room for real improvement; on the other hand, the use of powdered fuel under boilers is new, and while the thermal efficiency may be high, the cost of preparing the fuel and of constructing the furnace should be and is being greatly improved upon.

Already drastic modifications are being tried out which are said to show that the large furnace volumes now being called for are not necessary.

I have seen boilers controlled by one man sitting on a stool handling about 40,000 kW. While coal-firing we cannot reach the comfort of oil-firing conditions, but we can approach it; whether we accept the dates for oil shortage and famine which have been proposed by U.S.A. experts is not so important as the absence of any decided steps to develop alternative supplies.

Upon whom does the onus of taking the first practical step fall? It appeals to me as a national matter. Smokeless fuel is needed. Oils are needed. Gas and fertilisers are needed. Which is to be the product and which the by-product? Oil and gas Holzwarth turbines are reported after successful tests to be ready to come on the market. A 700-kW gas and a 300-kW oil turbine have already been run, and a 5,000-kW gas turbine is practically ready for running. The trials have shown high thermal efficiencies, and that the average temperatures to which the turbine blades are subjected do not exceed those obtaining in a modern steam turbine. We may expect the development of gas turbines to be rapid.

The Thermal Efficiency of Internal Combustion Engines.

Standards of Comparison.

On Tuesday last a joint meeting of the leading institutions and other bodies interested was held at the Institution of Civil Engineers to consider standards of comparison in connection with the thermal efficiency of internal-combustion engines. The discussion was opened with a note prepared by Mr. G. James Wells, A.M.Inst.C.E., of which the following is an abstract:—

Engineering progress demands the revision of standards and ideals from time to time, and the committee which has recently been appointed to revise the report of a previous committee on the Tabulation of the Results of Steam Engine and Boiler Trials (revised 1913) will, by virtue of the extension of its terms of reference, require to consider certain questions dealt with by an earlier committee which reported on the Efficiency of Internal-Combustion Engines (1905).

The 1905 committee reported in favour of the "air standard" as the then best ideal with which to compare the performance of internal-combustion engines, using air as the standard ideal working fluid, the specific heat of which was assumed to be constant. The committee stated definitely that these conclusions were only regarded as a temporary expedient, until such time as the requisite data were obtained, which would render possible a restatement of the ideals to be aimed at.

Sir Dugald Clerk, Prof. Burstall, the late Prof. B. Hopkinson, and others have done research work, which has widened our knowledge, and the critical and analytical work of others all help materially towards more rational definitions of ideals and standards.

The ideal simple standard cycles applicable are the well-

known "Constant-pressure" and "Constant-volume," together with the "Diesel" and "Dual combustion," the last two being combinations of the two first-mentioned. The thermal efficiencies of these cycles are stated usually in terms of temperature or of the compression ratio, but it is proposed to compute the efficiency in terms of the energy supplied and rejected in each cycle.

As regards the working fluid, it appears possible to replace the *imaginary air* with *constant specific heat*, by means of a gas mixture whose properties approximate more closely to those possessed by the actual gas mixture found in internal-combustion engines. The work of Sir Dugald Clerk, the British Association Committee on Gaseous Explosions, and a formula proposed by Dr. Stodola are examined and shown to be more closely in agreement than might be expected from the numerical values attached to the constants, and upon these a proposal is based that an imaginary fluid may be postulated with properties that give on the whole a fair approximation to the actual truth, certainly much closer than the air standard can possibly achieve.

The solution suggested is that, by means of a diagram (nomographic), and the data given by a mean indicator diagram, the temperatures, changes of total energy and internal energies may be found, in a manner somewhat similar to that employed in conjunction with a Mollier chart in connection with turbine problems. A sample table is added giving the internal and total energies reckoned from absolute zero of temperature, a sort of table of properties of gases for the use of internal-combustion engineers. An entropy chart is also combined with the nomogram, which enables the actual engine heat cycle to be readily compared with the suitable ideal cycle, thus giving directly a visual impression of the engine's departure from the ideal, and a quantitative measure of the relative efficiency.

The chart thus built up is then tested by means of published tests of a gas engine and two Diesel engines. In the case of the gas engine, three tests were published, and the efficiency figures found by means of the diagram were, respectively, 0.360, 0.359, and 0.357, as compared with the figure 0.3535 computed and published at the date of the tests. The diagram gave a mean pressure of 89 lb. per sq. in., which agrees exactly with that obtained from the cards. Similar results are obtained in the case of the Diesel engine.

Finally, it is claimed that the time has arrived when engineers should take the fullest advantage possible of the advances made in the knowledge of the behaviour of the gases in internal-combustion engines, to revise their standards and ideals for use in internal-combustion engine problems.

The London and Home Counties Electricity District.

Revised Scheme and New Inquiry.

It will be recalled that following the provisional delimitation in July, 1920, of the above-named area, schemes for the reorganisation of the supply of electricity therein were prepared by, respectively, the London County Council, the Conference of Local Authorities Owning Electricity Undertakings in Greater London, the London Electricity Joint Committee (1920), Ltd., the Metropolitan Borough Council of Poplar, the Great Eastern Railway Co., and the London, Brighton and South Coast Railway Co., which were considered by the Electricity Commissioners at the inquiry of June, 1921. As a result the Commissioners evolved a scheme that was embodied in the Draft Order of February, 1923, which was inquired into in March of the same year; the inquiry was, however, adjourned *sine die*, and the aforesaid scheme was not subsequently proceeded with.

The Electricity Commissioners have now arranged to hold a fresh inquiry on May 5th, at the Institution of Electrical Engineers, with respect to a new Draft Order that is based upon the above-mentioned prior scheme, but with modifications consequent on (*a*) the decision of the Court of Appeal in July, 1923, upon certain legal questions raised by the London electricity supply companies and others; and (*b*) the negotiations which subsequently took place between the London County Council and the London companies, as the outcome of which the Council in July, 1923, passed a resolution approving certain heads as a basis of settlement in relation to the London undertakings which are purchasable by the Council.

The basis of the proposed settlement has been provisionally approved by the Commissioners, who are advised, however, that complete effect cannot be given thereto by means of their Order, and that certain provisions in the London Electricity Supply (No. 1) Bill and the London Electricity Supply (No. 2) Bill now before Parliament are required to supplement the provisions of the new Draft Order and scheme.

The present scheme has been framed so as to provide for the immediate establishment of a Joint Electricity Authority for the district, but certain provisions affecting the London companies (*i.e.*, suspension of purchase powers of the Council, and the transfer of purchase powers) will not become operative until the companies have entered into agreements with the London County Council to give effect to the settlement provisionally approved. The scheme provides, as before, for the transfer or lease to the Joint Electricity Authority (by agreement) of the generating stations of local authorities and of specified inter-connecting mains in accordance generally with the original technical scheme agreed between the principal parties. The chief modifications embodied in the present scheme are as follows:—

(*a*) *Constitution of Joint Authority.*—The representation accorded to the London companies has been reduced by four, and that of the local authorities owning undertakings correspondingly increased, the number of publicly elected members now being 21 out of a total membership of 27.

(*b*) *Committees.*—Discretion is given to the Joint Authority as regards the appointment of, and delegation of powers to committees in lieu of the previous proposals for the compulsory appointment of, and compulsory delegation of powers to, a local authority committee and a London company committee.

(*c*) *Generating Stations and Main Transmission Lines of London Companies.*—The centralisation of generation in the areas of the London companies is to be secured either by the transfer or lease of the works to a new company or by an amalgamation of certain companies, instead of by the transfer or lease of such works to the Joint Authority and their operation by a company committee of that authority as proposed in the previous scheme. The London companies are also to carry out, after consultation with a Technical Advisory Board, the technical scheme scheduled to the draft Order so far as it concerns those companies.

(*d*) *Technical Advisory Board.*—The scheme provides for the setting up of a Technical Advisory Board to advise upon the carrying out of the technical scheme for the whole district and other matters. Consequent on the altered circumstances, the Board is differently constituted from the technical committee originally proposed. It is to be appointed in April in every third year, and will consist of one member (who shall be chairman of the Advisory Board and have legal qualification or commercial experience) to be selected by the Joint Authority from among the representatives of the Council on the Joint Authority; two members nominated by the Metropolitan borough councils being authorised undertakers; one nominated by the local authorities being authorised undertakers within the part of the district outside the county; two nominated by the London companies; one nominated by the power companies represented on the Joint Authority; and one by the railway companies represented on the Joint Authority. Excepting the chairman, all members of the Advisory Board must be corporate members of the Institution of Electrical Engineers.

(*e*) *Finance.*—The capital moneys required for the development of the generating stations and main transmission lines of the London companies will be raised by the new company or by an amalgamation of companies instead of by the Joint Authority, but the latter will have control (subject to an appeal to the Commissioners) as regards capital expenditure which will ultimately be repayable by the Joint Authority.

(*f*) *Suspension of Purchase Powers.*—The suspension until 1971 of the existing purchase powers of the London County Council in respect of the London companies is made conditional upon the consent under seal of the Council being given.

(*g*) *Transfer of Purchase Powers.*—The transfer affects the powers of the London County Council only and not those of local authorities outside the Administrative County of London.

The provisions relating to the proposed extension of tenure until 1971 to be granted to the London companies and the transfer of their undertakings to the Joint Authority at that date on special terms are dependent upon the execution of the agreements now being negotiated between the Council and the companies and the removal of certain statutory restrictions on the carrying out of the proposed settlement. An integral feature of the settlement will be the regulation, in accordance with a sliding scale, of the prices which may be charged by the London companies for electricity, and the dividends payable by them. It is anticipated that the proposed sliding scale will be published before the local inquiry; and when approved by the Commissioners it will be scheduled to the Order and form part of the scheme.

Belgium's Industrial Future.

In connection with the Belgian Government's policy of fostering export trade, Mr. J. Picton Bagge (H.M. Commercial Secretary at Brussels) mentions in his recent report* the movement towards economy in production. The Government, he says, has brought in a Bill for centralising the production and distribution of electricity, with a view to ensuring its widest possible use for lighting and power purposes. Important private companies have also amalgamated for a similar purpose.

For some time the demand for current has been greater than the existing power stations could supply. Many companies have consequently been obliged to increase their capital, among them being the Société Intercommunale Belge d'Electricité, the Société d'Electricité du Nord de la Belgique, and the Electricité et Gas du Nord. The plant capacity of the Soc. Intercommunale Belge d'Electricité rose from 54,650 kW to 79,250 kW during 1923, that of the Soc. d'Electricité du Nord de la Belgique from 26,120 kW to 36,991 kW, and that of the Cie d'Electricité du Bassin de Charleroi from 28,238 kW to 34,142 kW. Stations of over 15,000 kW number 12 (263,000 kW); stations of from 10,000 to 15,000 kW number 6 (63,100 kW); stations of from 5,000 to 10,000 number 9 (63,100 kW); stations of from 2,000 to 5,000 kW number 8 (25,745 kW); stations of from 1,000 to 2,000 number 4 (5,395 kW); stations of from 500 to 1,000 kW number 6 (4,433 kW); stations of less than 500 kW number 179 (11,187 kW); totalling 224, with a capacity of 435,960 kW.

In the province of Limburg, consequent on the development of the Campine coal basin and the industrialisation of this region, the increase of the use of electricity is remarkable. In January, 1923, the consumption amounted to 27,171 kW. In September the consumption was 104,180 kilowatt-hours. In this month alone 23 new connections with the system were made. These comprised five factories, one institute, and 17 communes. Further communes were connected in October. In the province of East Flanders a scheme embracing 91 communes with 220,000 inhabitants is under consideration. The outlay involved is 14 million fr. The province of West Flanders is likewise considering a scheme for the electrification of the whole province at a cost of 15 million fr.

Reducing Costs.

The metallurgical industries have shown special keenness in reducing factory costs, and are entering into combinations for effecting economies in fuel. In the Liége district a co-operative society of the central electrical power stations has been formed, linking up twelve metallurgical and mining companies of the district, and having a capacity of 100,000 h.p.

Makers of industrial equipment are reported to have full order books, notably for export. It is rather surprising to find that the official returns of Belgium's foreign trade furnish practically no details regarding her exports of electrical material. It is recorded, however, that during the ten months ended October 31st, machines and machine parts in steel were exported to a value of 134 million fr. The chief markets were France (48 millions), Spain (11), the Argentine (10), Great Britain (10), Brazil (7.7), and China (6). The same products in copper or other metals were exported to a value of 45 million fr., chiefly to Holland (13 millions), France (8), Great Britain (4), the Argentine, Spain, Switzerland, Norway, and New Zealand.

One additional source of wealth which Belgium has been actively exploiting during the past year is the Campine coalfield. It will fill a great gap in the country's need. The progress of this development will be judged from the fact that whereas in 1917 the production was only 11,640 tons, in 1923 (10 months) it was 653,000 tons.

The field possesses rich deposits of coking coal, and thus makes up for the deficiency in the older Belgian fields, while compensating for the cessation of deliveries of German coke and coking coal.

The natural consequence of this development is the industrialisation of the neighbouring districts, in which the copper, zinc, lead, tin, glass, radium, chemical, cement, and brick industries all play an important part. The Commercial Secretary makes special mention of the fact that the Campine Basin is becoming the complement of the mining districts of the Belgian Congo. The great radium factory at Oolen procures its raw material from the Congo, and factories are being established for the production of electrolytic copper and of cobalt metal and oxide of cobalt. It is expected that both these factories will commence operations in 1924. The electrolytic copper factory is being equipped for an initial annual output of 30,000-40,000 tons. It is admirably situated, in close proximity to the port of Antwerp, for deriving full advantage from the mining wealth of the Congo, and for its ultimate distribution on the world's markets in the form of finished or semi-manufactured products. In addition to its coal deposits, it is possessed of sand of exceptional quality for the glass industry, a speciality of Belgium. Communications with the district are being rapidly improved. The Government is annually assigning large sums to the construction of new railway lines, the improvement of certain existing lines, the extension of station and siding accommodation, the construction of main roads, and the building, widening and deepening of canals.

Telegraphs and Telephones.

Mr. Bagge records that a third line has been added to the Brussels-London service. As regards the projected subterranean cable between La Panne and Herbesthal for the international service, he remarks that no work was done during the year under review. Provision has, however, been made for its construction in 1924. The cost is estimated at 56 million fr. The total length of line of the telegraph system was 44,866 km. at October 31st, 1923.

Work began in December on the intercontinental radio station at Ruysleede. A sum of 8.2 million fr. is provided for its construction in the 1924 budget. The construction of this station, which is estimated to cost 16 million fr., is expected to occupy two years. It will be equipped with four steel masts of a height of 284 metres, and with high-power transmission plant capable of assuring regular communication with the Belgian Congo and North and South America.

With regard to telephones, the report says that a further automatic exchange was opened at Brussels during the year, and the conversion of another was commenced in November. It is expected that the remaining stations will be converted within the next two years. The development of the telephone system in Belgium is making enormous strides. At December 31st, 1913, the total length of lines was 318,235 km., while at October 31st, 1923, it had risen to 687,195 km.

The Société Belge Radio-Electrique, which was formed some 12 months ago, and in which the British Marconi Co. is interested, opened a broadcasting station in Brussels in November. This station has a wave-length of 410 metres, and is stated, with regard to its equipment, to be identical with the Marconi station in London. During recent trials messages transmitted were heard distinctly at Algiers, a thousand miles distant from Brussels.

Protecting the Worker.

In the section of Mr. Bagge's report which deals with social questions, he refers to a system of family allowances which has had most remarkable results in Belgium during the short period of its existence. It consists of payment additional to and completely independent of wages, made to workmen with families. Several groups of employers in the Verviers, Tournai, and Renaix districts, together with employers' federations in the zinc and building industries, decided to make an additional money payment to their workmen with families. Rather more than 12 months ago a permanent central committee was formed, and resulted in a wide expansion of the movement which now embraces firms employing over a quarter of a million workmen in different industries.

The mining industry, the federation of zinc, lead, silver, copper and nickel foundries, the national federation of building industries, and the plate-glass industry have all adopted the system, and many others, including the blast furnaces, steel works, rolling-mills and mechanical engineering works, have formed "Caisses de compensation." These were instituted in order to average the charges incurred in any one industry or district, and so to overcome the natural obstacle to the system—the difficulty that the father of a family might encounter in finding employment. The financial charges incurred are borne in their entirety by the employers. The allowances are not paid in the factory but at the workman's house. They are not uniform throughout the country. Their gradation depends on local conditions, on the average number of children per 100 workmen, and on the proportion of male and female workers employed in any one industry or district. The State has also adopted the system, and allowances are paid to civil servants and employés in the railways, marine, posts, telegraphs, and telephones. The rates were doubled during the present year. The estimated charge for 1924 is 27 million fr.

The report refers to the organisation of the Harwich-Zeebrugge ferry-boat service, which, it is pointed out, will be of great value to the British merchant in the export of many classes of fragile goods such as earthenware, from Great Britain to the Continent. At present British exporters are at a great disadvantage as compared with their Continental competitors in the trade in fragile and other products. British goods have to be carefully packed for purposes of transhipment, and handling charges are heavy. Foreign goods, on the other hand, can be packed in straw in the railway wagons, and be sent direct to their destination. This disadvantage will now be eliminated.

*D.O.T. & H.M. Stationery Office. Price 3s.

The Phœnix Telephone Works.

A New Hendon Factory.

The Phœnix Telephone & Electric Works, Ltd., the chief products of which are telephone apparatus and exchange equipment for the General Post Office and many of the oversea telephone services, recently acquired freehold premises comprising a large section of what were formerly aircraft manufacturing works at The Hyde, Hendon, and after reconstruction to suit its own special requirements, thus brought into existence an up-to-date factory which is affording employment for over 800 hands, both male and female.

The total area of the property is 2¼ acres, while the shops under cover occupy about 100,000 sq. ft. Six large bays, each 60 ft. by 200 ft., are given over to the power press

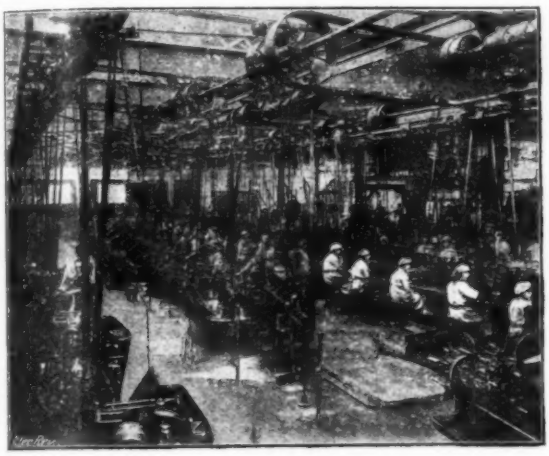


Fig. 1.—The Machine Shop.

department, machine shop (a portion of which is illustrated in fig. 1), the apparatus assembling department (fig. 2), switchboard section, cord machine and cord finishing shops; while such minor operations as coil winding, fuse and heat-coil making are undertaken on an extensive gallery whereon are also situated the company's own inspection department, and also the final inspection department of the British Post Office. Polishing, electro-plating, japanning, and lacquering processes are carried out in newly-erected separate buildings at the rear of the main works.

The glass roof affords excellent natural lighting, and attention has been paid to ventilation, while a sprinkler system, as a protection against fire, is installed throughout the buildings. A special welfare and first-aid organisation in charge of a qualified nurse is established as a separate department adjoining the factory proper.

The latest machine tools and labour-saving devices, amongst the former being a large number of automatic machines, are installed, and the machinery is driven by electricity. The artificial lighting system throughout the works comprises about 1,000 lamps of various candle powers, those in the machine shop being all of the gasfilled type of 400 c.p. each, giving splendid illumination of more than 30,000 c.p. In this department alone the average output is between 600,000 and 700,000 parts per week.

Some of the specialities of the Company's manufacture are telephone and switchboard cords and cords for radio apparatus. This department, we understand, is perhaps the best equipped of its kind in this country and, notwithstanding the fact that numerous machines and 200 hands are employed in this section alone, the output is insufficient to cope with the daily increasing demand.

A very enjoyable function was the dinner held on March 31st, at the Hyde Park Hotel, to celebrate the opening of the new works. Mr. H. Oppenheimer (managing director) occupied the chair, and, following the loyal toast, "The British Dominions" were toasted by Mr. Reginald Taylor (a director), Sir Joseph Cook, G.C.M.G., High Commissioner for Australia, responding. The chairman proposed "The Public Telephone Service," to which Col. T. F. Purves (engineer-in-chief of the G.P.O.) replied, as did also Mr. H. Sparks, O.B.E. (Controller of Stores, G.P.O.), and Mr. W. A. Valentine (controller of the London telephone service), who remarked that as that service was looked upon as an index of trade, it was encouraging to observe that during the last few months both the demand for new connections and also telephone traffic had been growing greatly and steadily. Mr. J. McLeod (of the Oriental Telephone & Electric Co., Ltd.) also spoke, dealing with the introduction and development of telephone service in Egypt, India, and other Eastern countries.

"The Telephone Manufacturing Industry" was proposed by Mr. Edwin J. Reid, and responded to by Mr. H. Hirst (chairman of the General Electric Co., Ltd.). Industry to-day, said Mr. Hirst, was not what he had imagined it to be as a young man—it was more like forced labour. Employers were now in the same position as the Government, that was, in office, but not in power. The one bright spot was the telephone industry, because in most countries that service was run by the Government, which could always find the necessary money for development and extension.

"The Ladies" were toasted by Dr. M. Epstein, M.A.

The Electrical and Engineering Exhibits at Wembley.

Preliminary Notices.

(*Continued from p. 528.*)

Berry's Electric, Ltd., is showing ironclad switchboards and switchgear and "Magicoal" fires, and is also supplying switchboards and distribution boards for the Government buildings.

The General Electric Co., Ltd., is arranging a very comprehensive display on its large stand. A large turbo-alternator set is to be shown in motion, with a part of the case removed; other exhibits are a 66-in. dia. Witton-Kramer lifting magnet; a belt conveyor; transformers; a complete range of d.c. and a.c. motors down to .02 h.p.; electric fans; traction equipments; railway signalling apparatus; domestic heating and cooking appliances, &c. The company is to have an electric kitchen, and a conference and kinema room for the display of manufacturing films, and many demonstrations of appliances are being arranged.

Electromotors, Ltd. (Manchester), will exhibit ranges of d.c. and a.c. motors, and two motor-generator sets.

Messrs. Siemens Bros & Co., Ltd., are to have a display of samples of submarine telegraph and telephone cables, power transmission cables, wires of all kinds, ebonite tube, rod, sheet, mouldings, &c., cells and batteries, telephone exchange equipment, telephones for various purposes, pyrometer installations, radio equipment, and broadcast receiving sets and accessories.

The Siemens & English Electric Lamp Co., Ltd., will exhibit incandescent electric lamps, distribution boards, fuses, and domestic appliances of numerous kinds.

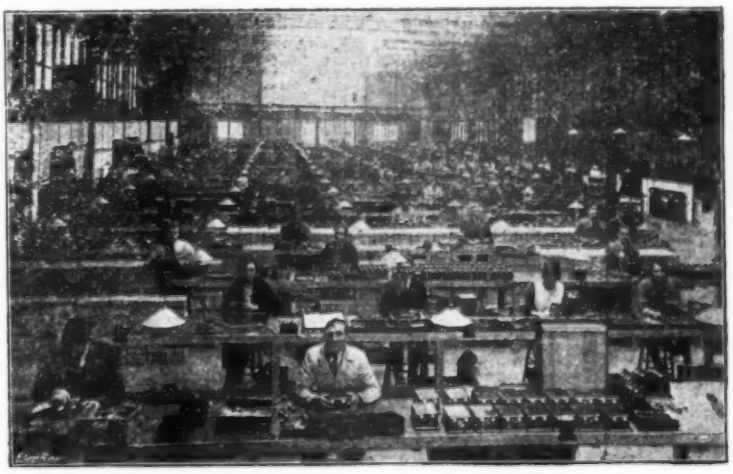


Fig. 2.—Apparatus Assembling Department.

Messrs. Elliott Bros. (London), Ltd., will show a.c. and d.c. indicating and recording meters, testing sets and apparatus, telegraph apparatus, revolution indicators and similar appliances, flow meters and recorder clocks.

The Semet-Solvay & Piette Coke Oven Co., Ltd. (Sheffield), is exhibiting models of "Piette" vertical flues, regenerative ovens, &c.

Messrs. Whipp & Bourne, Ltd. (Manchester), are to show a number of "Reliance" circuit breakers of various designs and ratings; a generator and feeder panel; cubicle gear; motor starters, fuseboards, &c.

Turner Bros. Asbestos Co., Ltd. (Rochdale), will exhibit asbestos in a number of forms—raw, cloth, sheets, packing, paper, &c., and also textile belting.

Messrs. E. Green & Son, Ltd. (Wakefield), are to exhibit full-size standard and ringstay economisers with electrically-driven scrapers, a tri-tube horizontal economiser with connecting bands, a rectangular tube air heater, specimen castings of accessories, &c.

Messrs. R. & W. Hawthorn, Leslie & Co., Ltd. (Hebburn-on-Tyne), will have a collection of model ships, a working model of a "Hawthorn-Armstrong" water-tube boiler, a storage battery locomotive, a 400-h.p. Lentz hydraulic transmission unit, a crane locomotive, &c.

The Vulcan Motor & Engineering Co. (1906), Ltd., in addition to the display of its motor vehicles, has supplied several of these to exhibitors for conveying goods to and from the Exhibition.

Messrs. Watson, Laidlaw & Co., Ltd. (Glasgow), will exhibit hydro-extractors, oil separators, and other centrifugal machines.

Messrs. Henry Robb, Ltd. (Leith), are to display models of tugs, dredgers, and other vessels.

Messrs. Davidson & Co., Ltd. (Belfast), will show machinery for treating tea, a number of "Sirocco" fans and air washers, heating and ventilating plant, and model dust collectors. The company is installing a "Sirocco" mine fan in the Exhibition colliery.

(To be continued.)

Fuel Economy.

Power Station Developments in the United States.

On Thursday last week a dinner was given by Vickers & International Combustion Engineering, Ltd., at the Hotel Cecil, London, in honour of three American engineers—Messrs. C. W. E. Clarke and F. H. Rosencrants, and Col. E. McCullough. Mr. Clarke is consulting engineer for Messrs. Dwight P. Robinson, Inc., of New York City, and has been responsible for the design of many super-stations in the United States, including the Colfax station of the Duquesne Light Co., of Pittsburg, and others where very large boilers are fired with pulverised fuel; Mr. Rosencrants is chief mechanical engineer of the Electric Bond & Share Co., an important subsidiary of the General Electric Co., U.S.A.; and Col. McCullough, a structural engineer connected with Messrs. Robinson, has had charge of the structural work on many of the stations designed by Mr. Clarke. The guests, who numbered about 100, included many central station engineers and others interested in power station practice. Sir Trevor Dawson, Bart., R.N., presided, and, after the loyal toasts, briefly explained that the gathering was to welcome the visitors and to emphasise the importance of the use of pulverised fuel, which would cheapen power and benefit industry generally, whilst turning colliery waste to good account. The system had been brought to this country by Mr. G. E. Learnard, who was present. Great progress had been made during last year in the United States, where boilers of two million sq. ft. of heating surface were fired with the Lopulco pulverised fuel system.

Mr. David Wilson, O.B.E., proposed "Our Visitors," and remarked that he was shortly going to the United States to see the system in operation; Mr. Clarke promised his complete conversion. In the United States Englishmen were sure of a most cordial reception, and were shown everything that they wished to see without restriction.

Mr. C. W. E. Clarke, responding, reviewed the progress made in the United States since the introduction of the steam turbine, culminating in such enterprises as that of the Commonwealth Edison Co., which would have plant of 700,000 kW at work next winter. Industrial development in the States was due to cheap power generated by large sets, and the use of pulverised fuel had now become established. Power station practice there was in a transitional stage; very large boilers and turbines were being installed, with air preheaters, high-speed economisers, feed-water heating by bleeding the turbines, and generator air cooling, whilst the use of pulverised fuel was rapidly growing. Mr. Clarke then showed a large number of lantern slides, and with their aid reviewed the changes in design of boiler houses that had taken place in recent years.

Mr. F. H. Rosencrants, also responding, said that the intense activity in the development of power generating plant in the United States in the last few years had enabled the designers to try out some of the ideas that had been suggested; to generate the kWh with an expenditure of 20,000 B.th.u. was good, but 18,000 was attainable, and they expected to reach 16,000. Plant of between two and three million kW was under construction. Boiler pressures ruled from 300 to 400 lb. per sq. in., with steam temperatures of 650 to 745 deg. F., but a pressure of 525 lb. was being used in three stations, and 1,200 lb. in one. For each new station a heat balance was compiled to serve as "bogey," and in some stations "bogey" was being closely approached.

Col. McCullough remarked that the use of pulverised fuel was suggested in England in 1860. A United States power station of to-day had to be built like a box, so that the engineer could rip out any part of the plant in the boiler house and change the design; steel construction was therefore necessary, but turbine-room design was more stable and permitted of the use of reinforced concrete.

Mr. George Usher proposed "Our Guests," and foreshadowed very great developments in the use of electricity in this country in the near future. One quarter of the coal mined was never brought to the surface; the pulverised fuel system however would enable this waste coal to be utilised.

Mr. J. Horace Bowden, responding, said that last year he paid a visit to the United States; he went in a sceptical mood, but returned convinced that the claims made for pulverised fuel were well founded.

Mr. Frank Hodges, P.C., M.P., also responded, referring to the adaptability of the American temperament, and to the advantages of the free exchange of technical experience. The geographical limitations which had been imposed upon electricity supply in this country must be broken down; the conditions here were most favourable to scientific co-ordination of effort, as distances were short.

On the invitation of the chairman, Sir Alex. Richardson made a few remarks, calling for the removal of obstructive legislation, and pointing out that the high wages paid in the United States were always earned, with the aid of mechanical power; the same conditions should be brought about here.

Sir George Hume, chairman of the Special Committee on London Electricity Supply of the L.C.C., and Mr. H. B. Atkinson, past-president, I.E.E., proposed and supported a vote of thanks to the chairman and his associates, and Sir Trevor Dawson briefly responded.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Chains for Conveying Machinery.

The design of chains for conveying and elevating machinery involves attention to a number of important points, *e.g.*, the securing of strength with a minimum of weight, good bearings in the joints, and small wear at the chain joints, while care must be taken that no castings are used as tension members. For the last reason the "malleable" chain is not perfect—its employment is limited by the strength of the castings. Castings have been eliminated from the "hollow stud" chains which are manufactured by Messrs. Hans

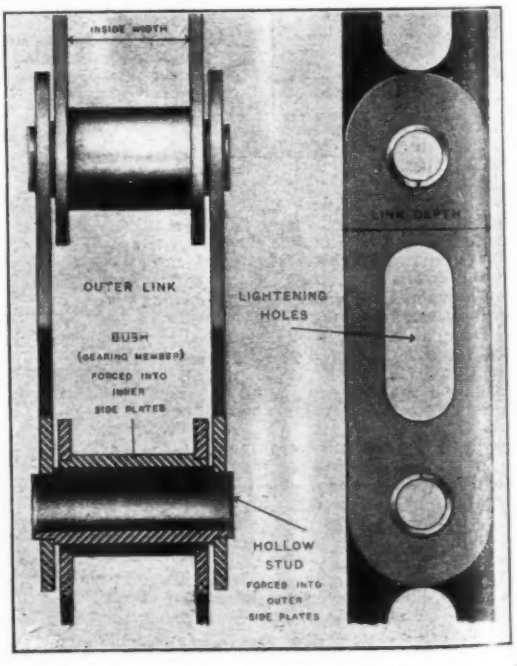


Fig. 1.—A "Hollow Stud" Chain.

Renold, Ltd., Burnage Works, Didsbury, Manchester. A typical chain of this type is illustrated in fig. 1. In this case the bushes which form the ends of the inner link are the gearing members; a similar design but with a roller can be supplied to bring the diameter up to that of the chain which is being displaced. The tubular or "hollow" rivets which are employed enable a large diameter rivet to be used for a given strength, and provide a simple means of fixing attach-

ments, as buckets, cradles, pusher plates, &c., to the chain. The side-plates are made of rolled steel, and consequently give the necessary tensile strength with minimum weight. The bushes and studs are made from rolled-steel strips formed to shape, or, in certain sizes, are machined from steel tubes. They are fixed into the side-plates rigidly by force fits that are correctly proportioned to the size of the parts. The wearing surfaces are smooth, and are case-hardened; thus the turning of the chain joints takes place between glass-hard polished surfaces which are very large in proportion to the load capacity of the chain. All parts of the chain are manufactured to fine limit gauges, and a measured length of 12 ft. is guaranteed by the company not to vary more than one-tenth of an inch from any other similar portion.

A Plug and Socket for Trailing Cables.

The accompanying illustration (fig. 3) shows a plug and socket connector, for employment with trailing cables, made by Mr. George Ellison, Perry Barr, Birmingham; this is of heavy construction, being of cast gunmetal. The fixed contact case is provided with a flange for bolting to a flat surface or over the cable entrance of a totally-enclosed circuit-breaker. A screw cap is provided for covering up the fixed contacts when the connector is out of use, and a deep gunmetal locking ring slides on the portable case and is screwed over the fixture when the parts are connected. When screwed home it ensures good contact and prevents accidental disconnection. The trailing cable is secured to the plug part

Fig. 2.—"Guardian" Valve Holder.

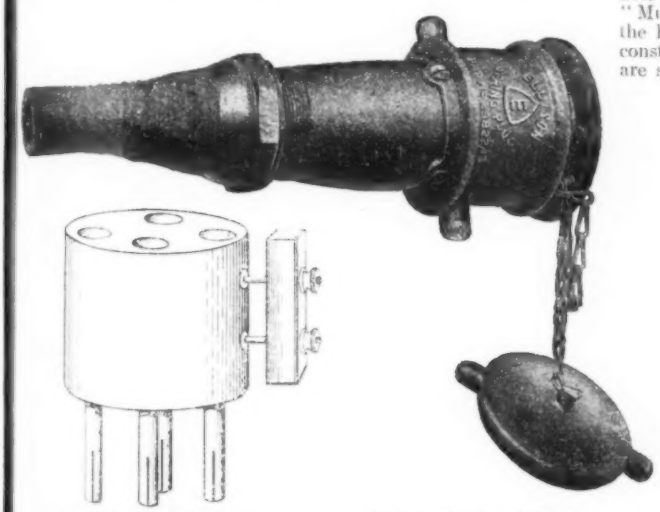


Fig. 3.—Plug and Socket for Trailing Cables.

by means of a wood bush tightened down by a conical gunmetal clamp. The terminal blocks are recessed to receive the cable strands under a clamp and specially shaped to assist the cable grip without a strain on the binding screws. The socket contacts consist of rings formed by phosphor-bronze spiral springs contained cylindrically in the terminal blocks. The plug contacts are round copper spears tapered to facilitate their entrance into the socket. The earth contacts are shaped differently from the line contacts and spaced unequally with them to ensure that the plug can be inserted in the correct way only, and that the earth connection is made before and broken after the line connection. The "live" parts are covered and held rigidly in position by substantial ebonite blocks pierced for the connections. As a further protection, the line terminal blocks are enclosed in cylinders of mechanically reinforced phenol-aldehyde insulators. The interiors of the fixed and portable halves of the connector are made interchangeable, so that either of the housings may contain plug or socket contacts. A plug box has been designed for use in docks, shipyards, and industrial works where a plug connection to the electricity supply is required at any point. The plug connection is made in one size only—for .06 sq. in. cable.

The "Guardian" Valve Holder.

A device which may save the owners of radio receiving sets much trouble and expense has been put on the market by Scientific Appliances, 11 & 29, Sicilian Avenue, Southampton Row, W.C.1. This, the "Guardian" valve holder (fig. 2) is similar to the usual pattern, but with the difference that the filament circuit, between the top socket and the plug, is interrupted. The space between the two parts is bridged externally by a plugged-in bar provided with a fuse wire. Thus the valve is protected against excess currents and consequent burning out.

A New French Electric Vehicle.

A new two-seated electric car on the lines of a petrol vehicle has lately been put on the market in France by the Société Electrocyclette, of 158, Avenue du Roule, Neuilly, Paris. A compound type of electric motor is used for driving purposes, being located at about the centre of the chassis, the power being transmitted to the back axle through the medium of a cardan shaft and bevel gear having a ratio of 3½ to 1. The battery is located under the usual bonnet at the front of the vehicle; it consists, as desired, of either a set of 16-V, 150-amp.-hr., 20-V 200-amp.-hr., or 20-V 250-amp.-hr. accumulators, the mileage on one charge ranging from 15½ to 28 miles. The vehicle is intended purely for town use, and an average speed of 19 m.p.h. can, it is claimed, be maintained.

The "Waltham" Reception Cushion.

For those "listeners-in" who easily tire of head-'phones, the Waltham Manufacturing Co., 2, Jackson Road, Holloway, N.7, has introduced a method of receiving radio-telephony in comfort. This takes the form of a cushion in which is embedded a telephone earpiece. The cushion is covered in cretonne and is provided with 12 ft. of flex.

The "Thermofan."

Until recently the method of producing hot air for various industrial purposes has been by means of two separate units—a heating battery and a fan to drive or pull air through the heater. These, together with the connections between them, take up a considerable amount of space, space which is often ill-spared.

The "Thermofan," made by Messrs. Matthews & Yates, Ltd., Cyclone Works, Swinton, Manchester, dispenses with the two units and combines them into one, thus saving valuable space, weight, and cost. It consists of the ordinary "Multivano" fan with a slightly enlarged casing into which the heating elements are placed. These heating elements are constructed of copper tubes with a large number of gills, which are specially designed to permit the air to pass freely through

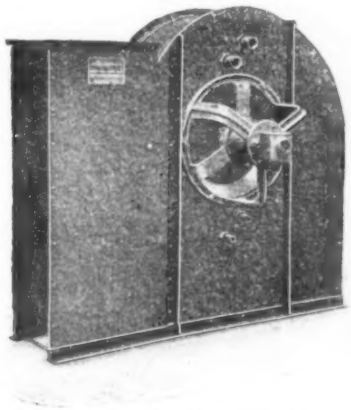


Fig. 4.—The "Thermofan."

to the outlet of the fan. Between the fan wheel and the heating elements are placed special guide plates or volutes for directing the air without loss of energy through the heating elements. The "Thermofan" is illustrated in fig. 4.

Correspondence.

Correspondents should forward their communications **at the earliest possible moment.** *No letter can be published unless we have the writer's name and address in our possession.*

The Recent Traffic Dispute.

Now that the tramway strike is settled it would be well to draw the attention of the public to the part the Electrical Trades Union played in the settlement. Once again, however, the scare Press told the people of London that the E.T.U. was going to put London in darkness. Once again, too, the Electrical Power Engineers' Association, brave men, rushed in to assure, or reassure, the long-suffering public that though the heavens might fall, and darkness reign supreme, they, the E.P.E.A., would act their usual trade union part. This, too, without making any inquiry as to whether the scare Press was telling the truth or not. Really, Mr. Jones, we are still on the telephone.

My Station Engineers Committee, at its weekly meeting on Monday, March 24th, instructed me to convene by telegram a special meeting in the event of: (*a*) any attempt being made to run a "scab" tramway service, or (*b*) any extension of the dispute to the tube railways, and the reason is fairly obvious. If either of these two things had happened our members would have been called upon to generate and distribute "juice" for blacklegs to use, and the E.T.U. is, above anything else, a Trade Union.

On Wednesday morning the papers conveyed the information that the A.S.L.E. & F. had instructed its members on

the tube railways of London to cease work at midnight on Friday, March 28th, and on inquiry this was confirmed by that Society's assistant general secretary, Mr. Moore. As a result the special meeting of my Committee was held that evening and a deputation from that meeting was appointed to wait on the Prime Minister the next morning.

The deputation, which consisted of four responsible station men and myself, saw the Prime Minister, Mr. Arthur Henderson and Mr. Tom Shaw the next morning, and urged them to do their utmost to bring the dispute to an end, with justice to the tramway men, before the dispute was extended to the railways. No threat was made with respect to the lights of London, but, of course, the grave position was pointed out to the Prime Minister and his colleagues, and it was very largely as a result of our deputation that the conferences which took place that night, and did ultimately end in a settlement of the dispute, were convened. I impressed upon my colleagues the danger of saying anything to any of the Press representatives who crowded round and no statement of any character was given. This was borne out by the London evening papers on Thursday, March 27th, and the *Evening Standard* referred to the conference as the "Mystery Meeting" with the electricians, who refused to make any statement.

Your readers can therefore imagine how I felt when I saw Friday's papers and found that the E.T.U. once again "topped the bill," but believe me, it is getting a bit painful to find that whenever there is a dispute in being then the good old E.T.U. is going to "dowse the glim." It does seem that whenever we appear on the scene the Press gentlemen run off to the nearest telephone box, and the "London in Darkness" automatically follows. Such is fame, and although neither my Committee nor myself object to the free advertisement given to the Electrical Trades Union, which is, by the way, a real Trade Union, we certainly think this "Darkness" stunt is a bit overdone, and would certainly suggest to your young men that in future they should view labour troubles in which the E.T.U. is involved from a "Lighter" standpoint.

There is, too, the danger from our side of the hedge. In my schoolboy days (unfortunately far distant), I read a "Wolf" yarn.

W. J. Webb,
London District Secretary, Electrical Trades Union.

London, *April 4th*, 1924.

[Our comrade "doth protest too much, methinks."—Eds. Elec. Rev.]

The History of Fused Silica.

I have just seen in your issue of March 21st Dr. Elihu Thomson's courteous acknowledgment of the work done by the Thermal Syndicate in the production of fused quartz ware for chemical purposes, and his explanation of the omission of any reference to this work in the article in the *General Electric Review* of February, 1923, to which I referred in my recent lecture before the Royal Society of Arts.

As Dr. Elihu Thomson expresses his great admiration for the work done by Dr. Hutton, and, following him, the Thermal Syndicate, it may be appropriate to mention that the chief credit for the work of the latter firm must be given to the late J. Frank Bottomley, Ph.D., whose death, due to influenza, at the early age of 46 years, must be deplored by all who were interested in the history of the commercial development of fused silica.

R. A. S. Paget.

London, *March 31st*, 1924.

A Would-be Mains Engineer.

May I venture to ask you of your generosity to publish this letter in your valuable columns in the hope that some of your numerous readers may be able to advise me?

I am 27 years of age, an ex-Service man, and am very keen to qualify as a mains engineer, but do not know how to set about it.

I have no mains experience, and, unfortunately, cannot afford to pay any premium, but would be willing to give my services until I was worthy of a wage. I have a fairly good theoretical and practical knowledge, but chiefly as applied to wiring.

My parents could not afford to apprentice me to the electrical trade, so that I have had to pick up my knowledge as best I could, chiefly by buying and reading all the books on the subject I could.

I hope I am not breaking any rules of professional conduct by writing this letter, but I really want to get on, and know no one to go to for advice except your valuable paper. For any advice I shall be most grateful.

Ignoramus.

April 1st, 1924.

The "Fusing of an Electric Wire."

I notice with great surprise that a fire at "Eaton Hall," a residence of the Duke of Westminster, has been ascribed by the daily Press to the fusing of an electric wire under the library floor. It seems unlikely that this can be the true cause of the fire, for one would suppose that in a mansion such as Eaton Hall, especially in the library, the very best system would be used, and then an electric fire would be impossible.

I think that all electrical engineers will agree that with an installation properly carried out in screwed conduit such an occurrence as that mentioned above is impossible, and I should say the same of many other systems, subject only to a qualification as to severe mechanical damage.

The old question of the fusing of an electric wire has thus again been brought into prominence by the lay Press, and yet even in the few cases where it does occur, it is almost invariably due to another primary fault, such as dampness or even a leakage of water.

F. Peake Sexton.

Westminster, *April 2nd*, 1924.

Bakers' Oven Hand Lamps.

From the Review's Service Department on the 4th inst. I note a query concerning a fireproof hand lamp for use in bakers' ovens. Many are the times that I have been up against this problem, without finding a satisfactory solution, wherefore I should be grateful if you would publish, and permit comment on, the following which I have in the past put into practice:—

Wire with two single C.T.S. cables a 4-ft. to 6-ft. length of 1 in. heavy gauge galvanised conduit or barrel, having 6 in. to 12 in. from the end a screwed 4-way junction piece or box. One of the outlets of the aforesaid box is equipped with a short length of tube or nipple, carrying a heavy type of lamp holder, a galvanised hand lamp guard, and a carbon filament lamp. A second or lower outlet of the 4-way junction piece has a short length of similar tube projecting downwards and terminating in a flange or back plate; the latter being cast into a block of lead, about 1½ in. to 2 in. thick, and, say, 8 in. in diameter. This forms a somewhat heavy, but substantial, base of peel-resisting properties, and keeps the lamp in position. Energy is derived from a substantial wall plug and switch on the oven exterior.

There should be a heavy type of flexible earth wire independently connected, preferably in duplicate, securely attached to the main conduit or tube.

In lieu of the secondary or duplicate earth connection possibly a swivelling trunnion Y fork or crutch earthed and set in the mouth of the oven, or a chain-suspended fulcrum at the mouth or oven door, similar to the old blooming mill or power hammer tongs of the puddling furnace industry of the North, might prove efficacious if effectively earthed.

W. E. Rogers, A.M.I.E.E.

London, *April 6th*, 1924.

Employment in Australia.

As the manager of a large electricity supply undertaking in Australia, I receive so many applications from England inquiring as to employment here that possibly the following notes may be of interest.

Generally speaking, employment in Australia, in all trades, is good; better in some than others, naturally. There are no officially unemployed. The demand for skilled artisans in the building trade, for bricklayers, carpenters, &c., is so insistent that private employers, and some of the State Governments, are doing all they can to encourage this class of artisan to come and settle here. The wages range from 25s. to 35s. per day. In general engineering, there is a fair demand for fitters and skilled mechanics, at from 16s. to 20s. per day. In the electrical trades the demand may be considered brisk for installation wiremen, electrical fitters, and mechanics, at from 17s. to 21s. per day. For power-house operatives, unless with some special skill or experience, the local supply is probably slightly in excess of the demand. As most electrical undertakings here adopt overhead lines for their systems of transmission and distribution, there is comparatively little scope or demand for engineers and others who are experienced in the laying and jointing of underground cables. Such undertakings as have underground cable installations are, broadly speaking, not extending them. On the other hand, the adoption of extensive overhead line systems, following closely on American practice, does call for a number of engineers and linesmen who have had this experience, and are capable of either designing or erecting this class of work. To such, this field offers fair prospects of employment, at about the same rates as for electrical mechanics.

To those young engineers with technical, but not special, experience, seeking staff technical positions out here, I would say they are likely to meet with difficulty unless they are prepared to take any class of work offering. Australia is already producing more technically trained electrical engineers than can be absorbed locally, and many have to seek positions elsewhere, generally in America, where they appear to obtain just that experience peculiarly required by Australian electrical conditions. Many of these return to Australia in course of time, and to the most lucrative positions offering. Generally speaking, I cannot recommend men over 40 years of age, unless with some particular skill or ability, to look to Australia for employment in the electrical industry. While the country offers many avenues of employment, the numbers required in each are limited. We have no established industries, apart from agriculture, capable of quickly absorbing

thousands, or even hundreds, of new arrivals at a time, but for reasonable numbers Australia as a whole does offer one of the finest opportunities for young men, with or without technical training, and not afraid of work, or too particular as to the class of employment. Sooner or later opportunity for appropriate positions will come their way.

The wages in Australia are generally regarded as high, but these are all fixed by Federal Arbitration Courts, and it is evident from many factors, such as the substantial homes, the Savings Bank deposits, and the amount of money spent on sport and amusement, that these awards do provide for a substantially higher standard of living and comfort than probably obtains at home, in spite of the fact that the cost of living here is generally conceded to be from 30 per cent. to 40 per cent. higher. If these Federal awards on the one hand are high, it must be pointed out on the other that employers similarly require a high degree of competency from the employé, and unless he possesses this he is not likely to remain long in one employment.

It will have been inferred, I trust, from the foregoing, that anyone contemplating seeking work in Australia will find it useless to make written application; only personal applications are ever considered. For any other information, he can obtain useful official advice either from any of the offices of the Agents-General for the various States, or from Australia House.

March 6th, 1924. **Anglo-Australian.**

A Potential Problem.

In connection with the correspondence *re* the above subject, the following may be of interest:—

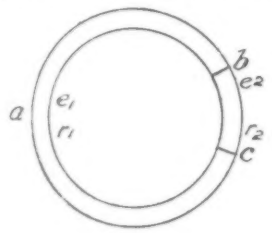


Fig. 1.

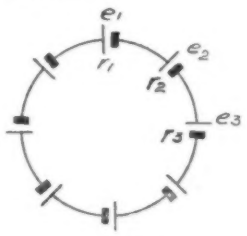


Fig. 2.

Let a b c be a ring of symmetrical dimensions, but having the resistance per unit length of the portion b a c different from the resistance per unit length of the portion b c.

Let r_1, r_2 be the respective resistances of the lengths b a c and b c, and let e_1 and e_2 be the respective electromotive forces set up in the lengths b a c and b c by the thrusting of a bar magnet along the axis of the ring; also let C be the current set up in the ring; then

$$\left.\begin{matrix}\text{Potential difference}\\ \text{between } b \text{ and } c\end{matrix}\right\} = Cr_2 - e_2;$$

therefore since

$$C = \frac{e_1 + e_2}{r_1 + r_2},$$

$$\left.\begin{matrix}\text{Potential difference}\\ \text{between } b \text{ and } c\end{matrix}\right\} = \frac{e_1 + e_2}{r_1 + r_2} r_2 - e_2$$

$$= \frac{e_1 r_2 + e_2 r_2 - e_2 r_1 - e_2 r_2}{r_1 + r_2} = \frac{e_1 r_2 - e_2 r_1}{r_1 + r_2}.$$

If the resistances per unit length of b a c and b c are equal, then

$$e_1 : e_2 :: r_1 : r_2,$$

or

$$e_1 r_2 = e_2 r_1,$$

for e_1 and e_2 will be in direct proportion to the lengths b a c and b c, and r_1 and r_2 will also be in direct proportion to b a c and b c; hence

$$e_1 r_2 - e_2 r_1 = 0,$$

i.e., there is no potential difference between b and c, and this, of course, applies to any two points on the ring.

Precisely the same result would be obtained if we joined up in series, as shown by fig. 2, a number of battery cells, *all of equal e.m.f. and resistance*; no potential difference would exist between any two points in the circuit.

If the cells were of different e.m.f.'s and resistances, then still no potential difference would exist between any two points in the circuit, provided

$$\frac{e_1}{r_1} = \frac{e_2}{r_2} = \frac{e_3}{r_3} = \ldots\ldots \frac{e_n}{r_n}.$$

On the other hand, if all the cells except one had similar e.m.f.'s and resistances, then potential differences would exist throughout the circuit unless *the ratio of the e.m.f. to resistance* of the one cell were equal to that of each of the other cells. In fact, we have the theorem:—"If any number of electromotive forces be joined in series so as to form a circuit, then if the ratio of the electromotive force to its resistance of each of the electromotive forces be equal, no potential difference will exist in the circuit."

Betchworth, *April 5th*, 1924. **H. R. Kempe.**

Charging for Low Power Factor.

I have noted with interest your discussion and explanations of power factor. Although your correspondence has closed, I hope you may find the following interesting.

It depends on, and therefore is only applicable to, a particular method of determining and assessing the extra charge due to poor power factor. In addition to the regular meter, measuring kilowatt-hours, an additional meter is installed with the coils connected at 90 degrees, so that it measures the reactive kilowatt-hours.

A standard power factor is selected as, for instance, 71 per cent. or 80 per cent.

For 71 per cent. power factor the reactive kilowatt-hours will be equal to the effective kilowatt-hours.

For 80 per cent. power factor the reactive kilowatt-hours will be 75 per cent. of the effective kilowatt-hours.

We would then say to the customer: "We will sell you kilowatt-hours at such and such a price. These are all you need to run a synchronous motor, for which you make your own magnetising current.

"If, however, you want to run an induction motor and want us to supply the magnetising current for the induction motor, we will make no charge for the magnetising current so long as you use only a reasonable amount.

"This reasonable amount would be the same as the effective kilowatt-hours for 71 per cent. power factor, or 75 per cent. of the kilowatt-hours for 80 per cent. power factor.

"If you want more magnetising current than this reasonable amount we shall have to charge you for it. We shall not charge the full rate that we charge for effective kilowatt-hours, but will only charge one-half or one-third as much."

While this method of assessing a power-factor penalty is not in general use, yet it will be found that if the standard power factor is selected somewhere between 75 per cent. and 85 per cent., then the magnetising current in excess of that needed at the standard power factor will be very nearly proportional to the actual increase in amperes over the amperes needed at the standard power factor.

Anyone interested can easily check this by calculation or by drawing the vector diagram. The proportion is, of course, not exact, but near enough for the practical purpose, which is to charge the customer enough for poor power factor so that he shall be incited to correct it when it is bad enough to warrant correction.

R. S. Hale,
Supt. Special Research Department.
Edison Illuminating Company of Boston.
Boston, U.S.A., *March 21st*, 1924.

Cost of Living in Japan.

I should be glad to know whether any reader can give information as to the cost of living in the large Japanese towns.

Have conditions changed greatly as a result of the earthquake?

Japan.

The Dutch East Indian Market.

A detailed survey of the Dutch East Indian market has been made in recent months by Mr. A. B. Muddiman, the Canadian Trade Commissioner, who has lately extended his investigations to the electrical trade. The district in which hydro-electric power has been most widely developed is West Java, electricity from the Bandoeng and Buitenzorg power stations being supplied to municipalities and private companies by the Government at cost price. Mr. Muddiman says that intense competition is encountered in all lines, and the cheapest goods have the largest sale.

Sixteen cities, he adds, have electric light and power, supplied by private companies. These include Bandoeng, Sourabaya, Semarang, Batavia, and Medan. Further, a great number of plantations and factories have their own electricity supplies.

Of the 5½ million horse-power of hydraulic energy which are estimated to be available throughout the Dutch East Indian islands, only 25,000 h.p. are being utilised, whilst another 25,000 h.p. are being devloped for a variety of purposes, including light and power in the cities, agriculture, factories, traction, and wireless telegraphy.

Mr. Muddiman proceeds to survey the prospects for sale of the various classes of electrical goods. On the island of Java, he says, about 60 miles of transmission lines for 25,000 volts and about the same length for voltages of from 3,000 to 5,000 volts are in use. On the island of Banka a 30,000-volt transmission line 60 miles in length is partly in use and partly under construction. On the island of Sumatra some 10 miles of 6,000-volt transmission line are in use, whilst a line for 25,000 volts 15 miles in length is under construction. Transmission lines for voltages up to 100,000 volts are planned.

Alternating current is generally used. Direct current is only in use in small plants in sugar mills. In regard to overhead wire, Mr. Muddiman points out that high-pressure wires, following the European principle, are always bare; low pressure wires are only insulated for crossing telephone lines,

&c. Underground laying, even in cities, is very uncommon. The Government is making an effort to standardise distribution of electric energy in all municipalities. Such standardisation in regard to voltages will save stocks of unnecessary spares being maintained by importers. The voltage for light is 220/127, and for power 380/220 on the four-wire principle. The voltage for high-pressure feeders is 30,000 a.c., and will in future be 70,000 a.c. All cables between transformers are armoured.

The Trade Commissioner reports a good demand for bare copper wire, but adds that prices have been cut drastically. He points out that it is no easy matter to obtain a suitable high-pressure insulator for a tropical climate, the rapid changes in temperature cracking porcelain insulators if at all faulty or not properly baked.

Mr. Muddiman gives a number of details regarding installation practice. Switchboards must have all conductors at least 5 cm. from the wall and be backed with fire protection, such as asbestos. No automatic switches should be used with ground wires. Single and double switches should have a contact surface carrying capacity of at least 4 amperes; triple pole and groups of switches at least 6 amperes. Switches in wooden cases may be used having a maximum current capacity of 35 amperes and a working pressure of 220 volts. Motors with a consumption of over 1 kW must be provided with automatic releases in their starting equipments. Metal-covered uninsulated switches are prohibited. Samples of all installation materials, such as wires, conduits, insulators, &c., should be deposited at Bandoeng in order that they may be approved by the authorities.

Metal conduits must be galvanised and smooth finished. Through walls and floors seamless conduits painted with white lead are to be used. Seamed conduits are not to be bent, or, if so, the seam must be underneath. Bent conduits must have a radius of at least 8 cm. at each bend. A common size of seamed conduit in use would appear to be ¾ in. and seamless ¾ in. in diameter. Storage batteries must be imported inert.

As to business prospects generally, there is a fair demand for special carbons for the projectors of moving pictures, which, Mr. Muddiman says, might be marketed through local film houses.

For bells and buzzers there is not a large demand, and as to electric torches it is difficult to compete with the Japanese. Electric cooking and heating appliances are not in vogue, neither are electric fans, although the Americans seem to be after the business. Mr. Muddiman thinks a demand might be created for small electrically-driven lighting sets in the sugar factories.

Published Specifications.

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Patent Agents.

The name of the applicant's patent agent, if any, will be found on the printed specification.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1922.

19,435. "Automatic telephone systems." A. F. Wood, W. Stott, and Telephone Manufacturing Co., Ltd. April 14th, 1923. (212,489.)

30,521. "Electric motor starters." J. A. Hirst and Brook, Hirst & Co. Ltd. November 8th, 1922. (Cognate application No. 4,173/23.) (212,601.)

30,828. "Electric cables." Eastern Telegraph Co., Ltd., and B. Davies. November 10th, 1922. (212,602.)

31,362. "Protective apparatus for alternating electric current distribution systems and apparatus." British Thomson-Houston Co., Ltd., and A. S. Fitzgerald. November 16th, 1922. (212,608.)

31,506. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. April 17th, 1922. (196,242.)

32,877. "Telephone systems." Relay Automatic Telephone Co., Ltd., and B. B. Johnson. December 1st, 1922. (212,610.)

33,700. "Dynamo-electric machines." British Thomson-Houston Co., Ltd., and A. P. Young. December 9th, 1922. (212,619.)

33,713. "Electric switches." J. A. Crabtree. December 11th, 1922. (212,620.)

33,818. "Trolley poles and the like." P. Robbins, J. Williamson, and G. Brander. December 11th, 1922. (212,622.)

33,905. "Electrical transmissions for direction purposes." Evershed and Vignoles, Ltd., and J. C. Needham. December 12th, 1922. (212,627.)

33,910. "Automatic control of dynamo-electric machines." British Thomson-Houston Co., Ltd., and C. J. Sarjeant. December 12th, 1922. (212,628.)

33,938. "Spark plugs for internal-combustion engines." A. E. White (Brewster Goldsmith Corporation). December 12th, 1922. (212,633.)

33,939. "Spark plugs for internal-combustion engines." A. E. White (Brewster Goldsmith Corporation). December 12th, 1922. (212,634.)

33,940. "Spark plugs for internal-combustion engines." A. E. White (Brewster Goldsmith Corporation). December 12th, 1922. (212,635.)

34,020. "Ignition systems for internal-combustion engines." H. E. Fellows. December 13th, 1922. (212,636.)

34,074. "Automatic telephone systems." Siemens Bros. & Co., Ltd., and J. Berry. December 14th, 1922. (212,640.)

34,162. "Coil ignition and electric lighting unit for motor-driven vehicles." D. A. V. Rist. December 14th, 1922. (212,644.)

34,174. "Protective devices for dynamo-electric machines." British Thomson-Houston Co., Ltd., H. C. Hastings, and C. J. Sarjeant. December 14th, 1922. (212,647.)

34,175. "Sound transmitters or emitters, such as telephone receivers." British Thomson-Houston Co., Ltd., J. H. Butcher, and A. P. Young. December 14th, 1922. (Cognate application 10,117/23.) (212,648.)

34,212. "Anti-dazzle devices for motor-car head-lights or other lamps." H. C. Twigge. October 15th, 1923. (212,650.)

34,220. "Combined electrical, gas, and mechanical burglar alarm." C. Couch. December 15th, 1922. (212,651.)

34,298. "Systems of electric motor control." British Thomson-Houston Co., Ltd., and H. C. Hastings. December 15th, 1922. (212,656.)

34,451. "Electrical switch." J. Pownall. December 18th, 1922. (212,661.)

34,527. "Electric motors." Lancashire Dynamo & Motor Co., A. P. Wood, R. S. McLeod, and W. Stansfield. December 19th, 1922. (212,664.)

34,640. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd., and C. Gillings. December 19th, 1922. (Addition to 193,694.) (Cognate application No. 3,570/24, a divided application on 34,640/22.) (Addition to 193,694.) (212,666.)

35,437. "Systems of control for dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co.). December 29th, 1922. (212,676.)

1923.

460. "Automatic and semi-automatic telephone systems." Relay Automatic Telephone Co., Ltd., and R. Mordin. January 5th, 1923. (212,682.)

2,664. "Electric current-distributing systems." E. W. Marchant. January 29th, 1923. (212,700.)

2,906. "Device for testing ignition and lighting circuits of motor vehicles." D. J. Owen. January 31st, 1923. (212,702.)

3,125. "Protective apparatus for use in conjunction with high-voltage electric supply systems." Electric Control, Ltd., and J. E. Stewart. February 2nd, 1923. (212,705.)

4,762. "Magneto-electric hand lamps." A. H. Railing and A. E. Angold. February 19th, 1923. (212,724.)

5,167. "Packing devices for electric lamps and other articles." J. Magino. February 22nd, 1923. (212,727.)

5,212. "Terminals for electrical transformers." J. B. Hansell, B. Beesley, and Metropolitan-Vickers Electrical Co., Ltd. February 22nd, 1923. (212,728.)

5,854. "Cut-out arrangements for electric traction systems." Fabrik Elektrischer Apparate Sprecher and Schuh Akt. Ges. in Aarau. July 12th, 1922. (200,782.)

6,672. "Electric sound-producing horns." W. A. Crosbee. March 8th, 1923. (Addition to 185,650.) (212,734.)

7,871. "Automatic illuminated signal hand for vehicles." S. State. March 19th, 1923. (212,746.)

8,834. "Method of, and means for, preventing arc formation and sparking in commutators, interrupters, and the like electric switches." E. Benedetti. March 28th, 1923. (212,756.)

9,186. "Hydrometers for testing electric accumulators." J. H. Runbaken and W. Torrance. April 3rd, 1923. (212,759.)

9,618. "Sparking plugs." R. Bosch Akt. Ges. May 23rd, 1922. (198,345.)

12,984. "Method of opening electric incandescent lamps." General Electric Co., Ltd. June 1st, 1922. (198,660.)

14,776. "Method of balancing self-inductions and effective resistances for electric cables with artificially-increased self-induction." J. S. Mollerhoj. June 5th, 1923. (212,793.)

16,950. "Arc lamp carbons and electrodes." Paul-Schiff & Co. and Dr. A. Borchers. July 27th, 1922. (201,537.)

17,329. "Electrical precipitation of suspended particles from gaseous fluids." Lodge-Cottrell, Ltd. (Metallbank und Metallurgische Ges.). July 4th, 1923. (212,811.)

19,794. "Electric safety fuse." T. H. Koloman. August 2nd, 1923. (212,821.)

20,746. "Electric safety fuses." W. Hickel and O. Pleischer, Junr. August 15th, 1923. (212,824.)

20,922. "Insulators for supporting transmission lines." Lodge-Cottrell, Ltd. (Metallbank und Metallurgische Ges.). August 17th, 1923. (Addition to 202,539.) (212,826.)

22,651. "Electric switches." J. A. Crabtree. December 11th, 1922. (Divided application on 212,620.) (212,838.)

22,652. "Electric switches." J. A. Crabtree. December 11th, 1922. (Divided application on 212,620.) (212,839.)

24,119. "Electromechanical apparatus for working and controlling points for railways and the like." A. Monard. September 27th, 1923. (Addition to 180,992.) (212,842.)

25,121. "Lifting magnets." F. Krupp Akt. Ges. October 24th, 1922. (206,130.)

26,145. "Cable-guiding devices for mobile electrical machines." N. R. Forssblad. October 20th, 1922. (205,821.)

27,454. "Supports for electric motors driving spinning machines." Metropolitan-Vickers Electrical Co., Ltd. November 3rd, 1922. (206,508.)

29,591. "Process for re-activating adsorption media with the simultaneous recovery of the adsorbed products by means of electrically-generated heat." Naamlooze Vennootschap Montaan Metaalhandel. November 23rd, 1922. (207,547.)

1924.

455. "Sound-emitting apparatus, such as telephone receivers." British Thomson-Houston Co., Ltd., J. H. Butcher, and A. P. Young. December 14th, 1922. (Divided application on 212,648.) (212,857.)

Canada's Water-Power Resources.—A report compiled by the Dominion Water Power Branch of the Canadian Department of the Interior shows the state of the hydro-electric industry as at February 1st, 1924. It is stated that during 1923 there was an increase of over 750,000 h.p. in the developed power, bringing the total development up to 3,227,414 h.p. According to the latest available information the total minimum water-power possibilities amount to 18,255,000 h.p. Under a flow estimated for maximum development, *i.e.*, dependable for at least six months of the year, the figure is raised to 32,076,000 h.p. The average machine installation is 30 per cent. greater than the six-month flow maximum power, and applying this to the figure quoted above it appears that the present recorded water-power resources of the Dominion will permit of a turbine installation of 41,700,000 h.p. The total installation in water-wheels and turbines is at present 3,227,414 h.p.—or only 8 per cent. of the recorded water-power resources. Further developments, however, are in course of construction amounting to more than 900,000 h.p. The developed power may be classified as follows:—2,411,701 h.p. in central stations for general distribution for all purposes; 497,630 h.p. installed in pulp and paper mills, not including 238,755 h.p. purchased by the companies from central stations; and 318,093 h.p. installed in other industries. The installation averages 353 h.p. per thousand population, a figure which places Canada third in the *per capita* utilisation of water-power among the countries of the world, after Switzerland and Norway. The development of high transmission pressures has permitted power to be carried over long distances at small loss, leading to the development of sites distant from large towns and industrial centres. The use of the electric drive is having a markedly beneficial influence upon the pulp and paper industries. The water-power installations of the Dominion represent an investment of $687,000,000, and it is estimated that by 1940, if the present rate of growth continues, Canada will have developed 7,000,000 h.p., at a cost of $1,500,000,000.